The world's most comprehensive encyclopedia of the military weapons of the 20th century

WAR MACHINE

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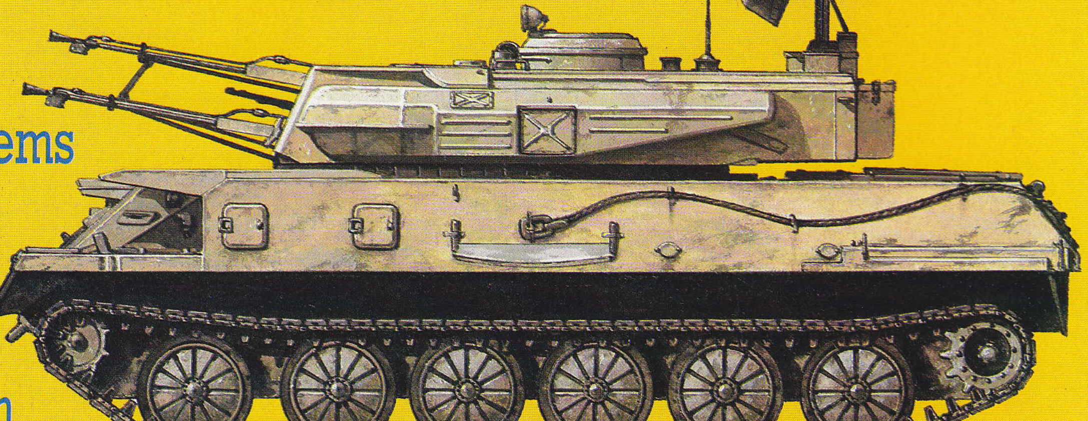

Trends in SPAAG systems

Air Defence of the American Division

The SPAAG in Vietnam

A fully illustrated guide to Modern Self-Propelled Anti-Aircraft Guns

WAR MACHINE

Volume 4 **Issue 40**

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Editorial Offices
War Machine
Aerospace Publishing Ltd
10 Barley Mow Passage
London W4 4PH

Managing Editor: Stan Morse
Editorial: Trisha Palmer
Chris Bishop
Chris Chant
Jon Lake

Design: Rod Teasdale
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Peter Sarson & Tony Bryan

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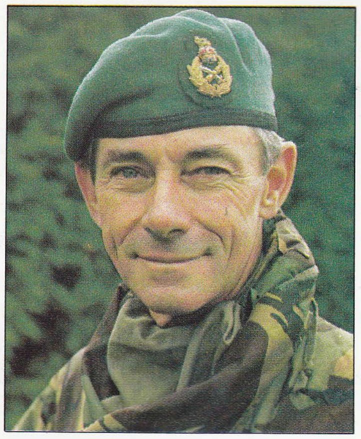

Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

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Orbis House
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London WC2N 4BT
Telephone: 01-379 6711
Circulation Director: David Breed
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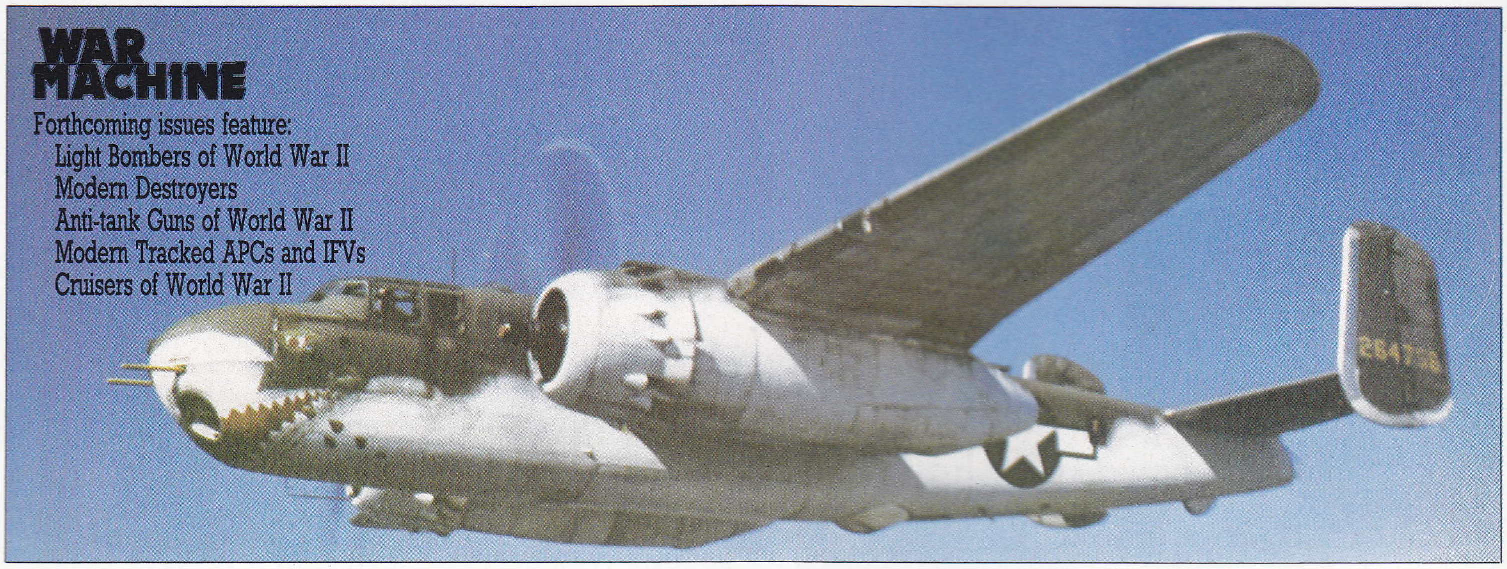

WAR MACHINE
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- Modern Destroyers
- Anti-tank Guns of World War II
- Modern Tracked APCs and IFVs
- Cruisers of World War II

Modern Self-Propelled Anti-Aircraft Guns

Like many armies, the USA uses self-propelled anti-aircraft guns in its air defence. The twin 40-mm guns of the M247 Sgt York significantly enhance American capability against airborne threats.

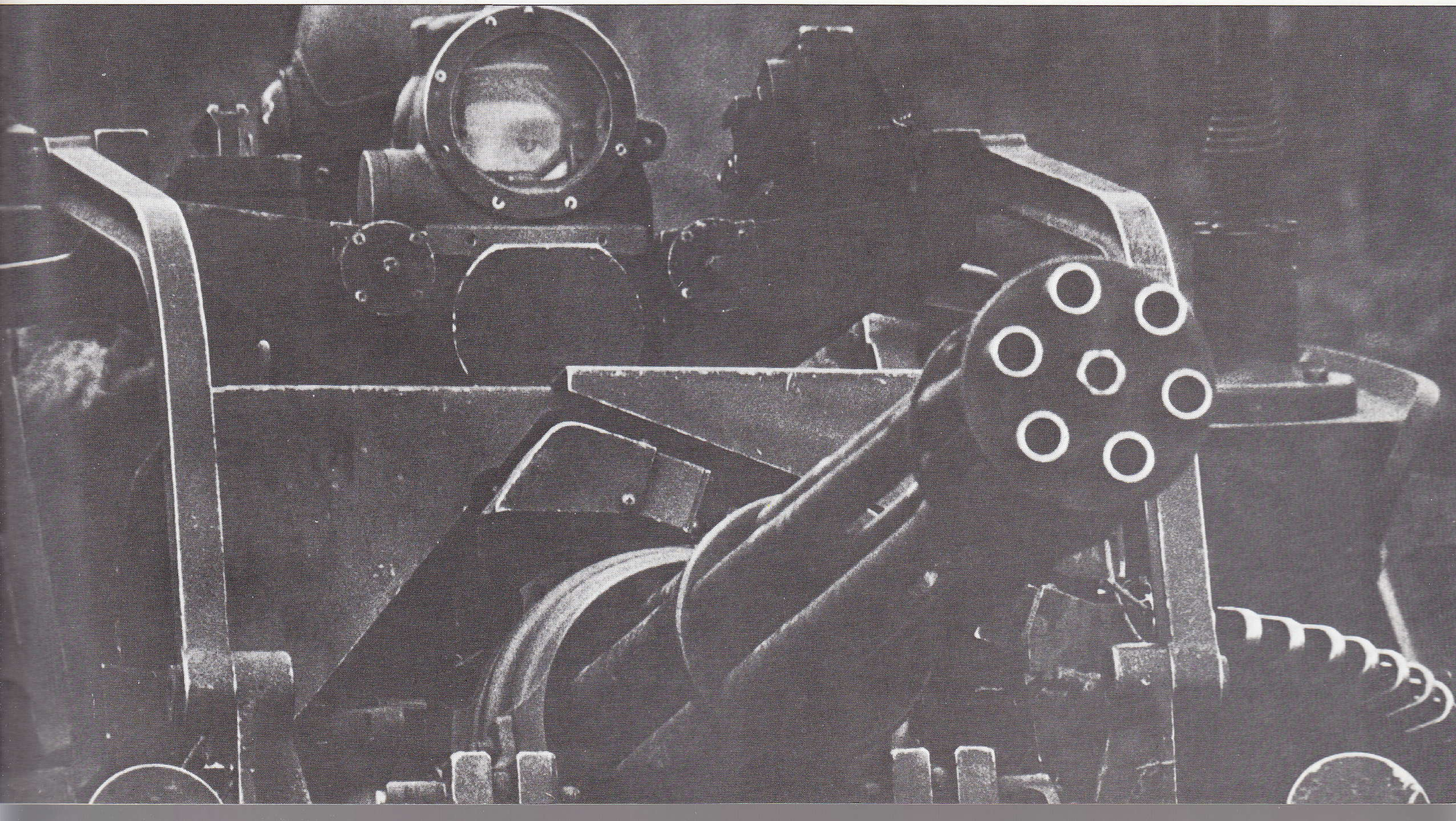
The rise in tactical air power has added a new dimension to the modern battlefield. Aircraft can now deliver sophisticated, accurate weaponry in high-speed, low-level attacks, and defences have had to evolve to meet the threat. To most armies, that means missile defences, but an important component in overall battlefield air defence is provided by gun systems.

To many people, the term 'mechanized forces' means just tanks and armoured personnel carriers/mechanized infantry combat vehicles. While these are numerically the most important, without the support of engineers, self-propelled artillery, air-defence systems, army aviation and other supporting arms they cannot survive on the high-intensity battlefield of today. Armies approach the air-defence element of their forces in quite different fashions, some (the British, for example) relying only on surface-to-air missiles (SAMs), while others (the Americans, Soviets and West Germans, for example) have a mix of guns and missiles.

Guns and missiles are complementary, the missile taking care of the longer ranges and the guns providing close-in defence. The USSR has by far the most 'in-depth' array of air-defence weapons ever seen, and many of these have been used operationally in Africa, Middle East and the Far East in recent years. In addition close-in defence can be provided by man-portable missiles such as the SA-7 and Stinger, by machine-guns mounted on top of vehicles from tanks down to trucks, and even by the individual soldier firing a rifle or machine-gun into the air, the whole object of the exercise being to put as much fire into the air as possible. While the chances of an infantryman hitting a fast and low-flying aircraft are fairly remote, it does give him a sense of purpose in hitting back at the enemy.

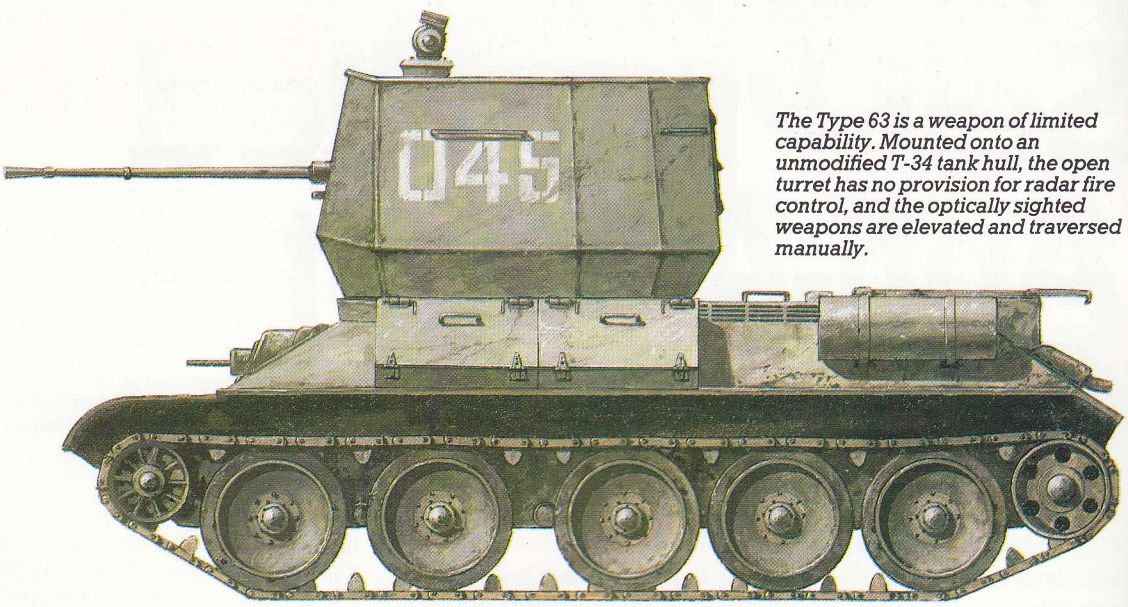
Some of the self-propelled anti-aircraft gun systems described here are clear-weather systems only, while others can engage targets under a variety of weather conditions. In many parts of the world clear-weather systems are more than adequate to deal with the air threat, especially if potential enemies lack all-weather aircraft. Often the more complicated systems, although more effective, are not only more expensive to procure but difficult to operate and to maintain, especially in under-developed parts of the world.

On the alert for intruding aircraft, the six barrels of an American Vulcan 20-mm cannon nose hungrily skyward. Seen here on exercise in Korea, the Vulcan has been in service with the US Army since the late 1960s.



CHINA

Type 63 twin 37-mm self-propelled AA gun



The Type 63 is a weapon of limited capability. Mounted onto an unmodified T-34 tank hull, the open turret has no provision for radar fire control, and the optically sighted weapons are elevated and traversed manually.

The Soviet Union supplied China with considerable amounts of military equipment in the 1950s and 1960s before the breaking-off of relations between the two countries. To meet its needs for a self-propelled anti-aircraft gun system China used the T-34 series tank chassis with its turret replaced by a new open-topped turret armed with twin 37-mm anti-aircraft guns; this gun was already in service with the Chinese army, mounted on a four-wheeled carriage. The chassis of the **Type 63** is identical to that of the tank with the driver at the front left and bow machine-gunner to his right, though it is probable that the bow machine-gun was removed. The turret is in the centre of the hull with the engine and transmission at the rear. The Christie-type suspension has five dual rubber-tyred road wheels, with drive sprocket at the rear and idler at the front; there are no track-return rollers as the top section of the track rests on the upper part of the road wheels.

The twin 37-mm cannon are recoil-operated and have a cyclic rate of fire of 160 to 189 rounds per minute, but practical rate of fire per barrel is 80 rounds a minute. Weapon elevation and turret traverse are manual, which would be a major tactical drawback in the engagement of aircraft flying at low level and high speed. Only optical sights are fitted, with no provision at all for radar fire-control. The ammunition is fed to each weapon in clips of five rounds, some ready-use ammunition being stowed inside the turret with the bulk of the ammunition stowed externally in panniers on each side of the hull. Two basic types of ammunition are fired, FRAG-T (fragmentation tracer) being used against aerial targets and AP-T (armour-piercing tracer) being used against armoured targets such as light tanks. Both projectiles have a muzzle velocity of 880 m (2,887 ft) per second, and the AP-T round will penetrate 37 mm (1.46 in) of armour at a range of 1000 m (1,095 yards) or 46 mm (1.81 in) of armour at a range of 500 m (547 yards), penetration being better at shorter ranges because of the projectile's higher velocity. Effective anti-aircraft range is 3000 m (3,280 yards), although maximum vertical range is 6700 m (21,980 ft).

The Type 63 was supplied to the Viet Cong, from whom one equipment was subsequently captured by the South Vietnamese and sent to the United States for evaluation at Aberdeen Proving Ground, where it is now on display at the Ordnance Corps museum. As far as it is known China was not supplied with any 57-mm ZSU-57-2 or 23-mm ZSU-23-4 self-propelled anti-aircraft guns by the Soviet Union, although China has been producing its own tanks, armoured personnel carriers, towed artillery and rocket launchers for some years. There is no evidence that China has developed any self-propelled anti-aircraft gun systems apart from the Type 63, though it must be assumed that because of the very limited capabilities of the Type 63 such development is taking place; so there may well be a new Chinese designed self-propelled anti-aircraft gun already in service. There is already considerable exchange of technical information and equipment between China and Egypt, and the latter could have transferred numbers of ZSU-23-4 and ZSU-57-2 systems for study and perhaps eventual production in China.

This Type 63 was supplied to the Viet Cong, from whom it was captured by the US Forces during the Vietnam war.

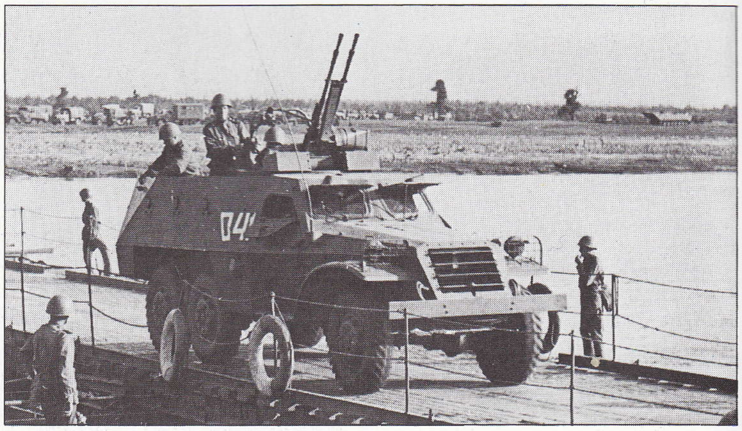
Specification (provisional)
Type 63
Crew: 6
Weight: 32000 kg (70,547 lb)
Dimensions: length (guns forward) 6.432 m (21 ft 1 in); length (hull) 7.53 m (24 ft 8 in); height (turret top) 2.995 m (9 ft 10 in)
Powerplant: one V-12 water-cooled diesel developing 500 hp (373 kW)
Performance: maximum road speed 55 km/h (34 mph); maximum range (road) 300 km (186 miles); gradient 60 per cent; vertical obstacle 0.73 m (2 ft 5 in); trench 2.5 m (8 ft 2 in)

USSR

BTR-152A twin 14.5-mm self-propelled AA gun

While the ZSU-57-2 twin 57-mm SPAAG was the first purpose-built weapon of its type to be introduced into the Soviet army in large numbers during the post-war period, the **BTR-152A** (6×6) and BTR-40A (4×4) entered service some years before. In both cases these were essentially armoured personnel carrier chassis with the normally-towed twin 14.5-mm (0.57-in) KPV heavy machine-guns turret-mounted in the troop compartment at hull rear. The turret is designated the ZPTU-2 and can be traversed through 360°, the weapons being able to elevate −5° to +80°. The KPV machine-gun is also fitted in a number of Soviet armoured vehicles including the BRDM-2 (4×4) amphibious scout car and the BTR-60PB and BTR-70 (8×8) armoured personnel carriers. It was also installed as the co-axial and anti-aircraft weapon of the T-10M heavy tank, which is no longer in front-line service with the Soviet Union. There are also three versions of the towed KPV heavy anti-aircraft machine-gun: the ZPU-1 (single), ZPU-2 (twin) and ZPU-4 (quadruple). In the Warsaw Pact most of the towed ZPUs have been replaced by the 23-mm ZU-23 anti-aircraft gun, and the BTR-152A and BTR-40A each remain in front line service only outside the Soviet Union.

The KPV heavy machine-gun has a



The BTR-152A has been used operationally in Vietnam and the Middle East in both AA and fire support roles.

cyclic rate of fire of 600 round per minute per barrel, but its practical rate of fire is 150 rounds per minute per barrel. The method of operation is gas-assisted short recoil. The barrel is air-cooled, is fitted with a flash eliminator and a handle for carrying out quick changes, and is chromium-plated internally to reduce barrel wear. Two types of ammunition, API and HEI-T, are fired. The armour piercing incendiary round is used mainly against armoured vehicles and will penetrate 32 mm (1.29 in) of armour at a range of 500 m (547 yards). The high explosive incendiary-tracer (HEI-T) round is used against aircraft. Only optical sights are fitted, there being no provision for radar fire-control. This limits the system's capability to clear-weather operations only. The lack of power traverse and elevation also limits the system's capability to engage fast-moving targets at low level.

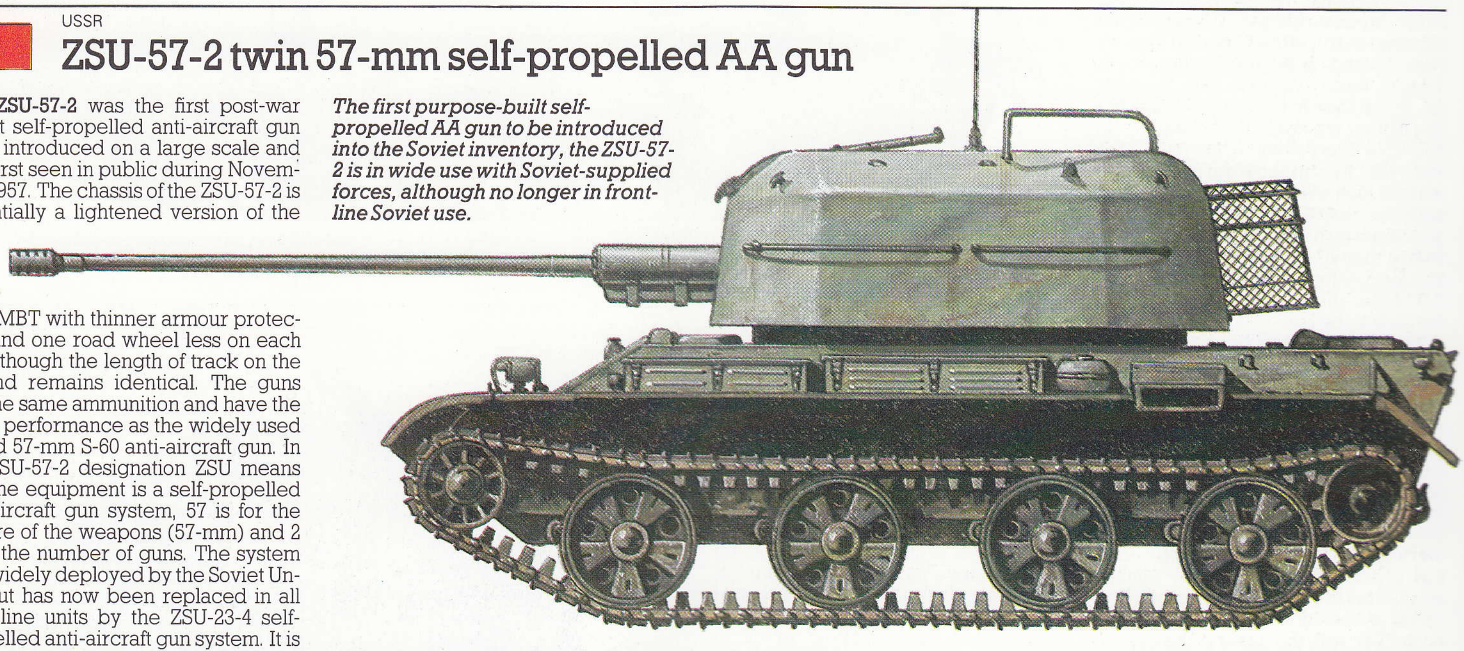
In addition to being used in its originally-designed anti-aircraft role in the Middle East and Vietnam, the system has also been used in the ground fire-support role, in which its high rate of fire has proved most useful. During the fighting in the Lebanon in the summer of 1982 the Israeli army captured a number of BTR-152 APCs with the more effective twin 23-mm ZU-23 cannon mounted in the rear, but as far as is known this was a local modification.

One of the more interesting local modifications carried out by Egypt on the BTR-152 was the installation of the Czech quadruple 12.7-mm (0.5-in) M53 machine-gun mounting in the rear of the vehicle. The weapons have a lower cyclic rate of fire than the KPV and also a shorter effective range.

Specification
BTR-152A
Crew: 4
Weight: 9600 kg (21,164 lb)
Dimensions: length 6.83 m (22 ft 5 in); width 2.32 m (7 ft 7 in); height (overall) 2.70 m (9 ft 2 in)
Powerplant: one ZIL-123 6-cylinder petrol engine developing 110 hp (82 kW)
Performance: maximum road speed 65 km/h (40 mph); maximum range 780 km (485 miles); gradient 55 per cent; vertical obstacle 0.60 m (2 ft); trench 0.69 m (2 ft 3 in)

USSR

ZSU-57-2 twin 57-mm self-propelled AA gun



The first purpose-built self-propelled AA gun to be introduced into the Soviet inventory, the ZSU-57-2 is in wide use with Soviet-supplied forces, although no longer in front-line Soviet use.

The **ZSU-57-2** was the first post-war Soviet self-propelled anti-aircraft gun to be introduced on a large scale and was first seen in public during November 1957. The chassis of the ZSU-57-2 is essentially a lightened version of the T-54 MBT with thinner armour protection and one road wheel less on each side, though the length of track on the ground remains identical. The guns fire the same ammunition and have the same performance as the widely used towed 57-mm S-60 anti-aircraft gun. In the ZSU-57-2 designation ZSU means that the equipment is a self-propelled anti-aircraft gun system, 57 is for the calibre of the weapons (57-mm) and 2 is for the number of guns. The system was widely deployed by the Soviet Union but has now been replaced in all front line units by the ZSU-23-4 self-propelled anti-aircraft gun system. It is still used by Algeria, Angola, Bulgaria, Cuba, East Germany, Egypt, Ethiopia, Finland, Hungary, Iran, Iraq, North Korea, Poland, Romania, Syria and Yugoslavia. In 1982 the Syrian army made extensive use of the ZSU-57-2 in the ground-support role during fighting in the Lebanon.

The chassis is of all-welded steel construction, with the driver at the front left, the other five crew members in the open-topped turret in the centre of the hull, and the engine and transmission at the rear. Suspension is of the torsion-bar type with the drive sprocket at the rear and the idler at the front; there are four road wheels but no track-return rollers. As the ZSU-57-2 is lighter than the T-54 tank on which it is based it has a higher power-to-weight ratio of 18.56 hp/tonne and a lower ground pressure. To extend its operating range to 595 km (370 miles), long-range fuel tanks can be fitted at the rear of the hull.

The twin 57-mm cannon are power-operated from −5° to +85° at 20° per second, with turret traverse through 360° at a speed of 30° per second; manual controls are provided for emergency use.

Each gun has a cyclic rate of fire of 105 to 120 rounds per minute, though the practical rate of fire is 70 rounds per minute. Ammunition is fed to each weapon in clips of four rounds, the empty cartridge cases and clips being deposited onto a conveyor belt under the weapon. This runs to the turret rear and drops the empty cartridge cases and clips into the large wire basket mounted externally at the turret tear.

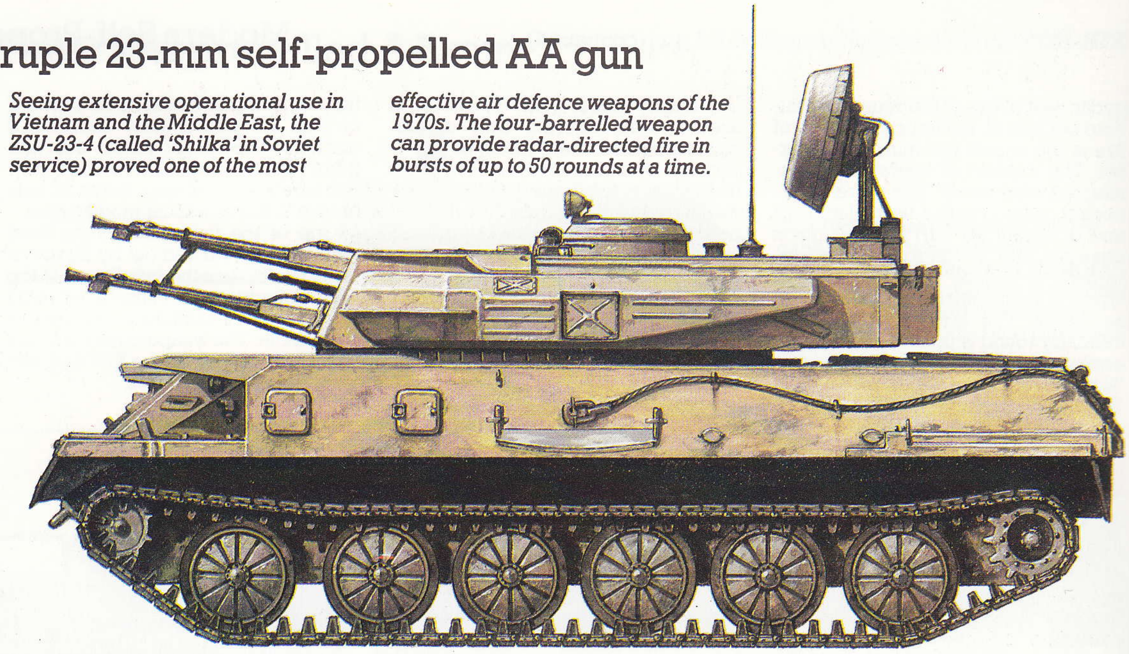
The following types of fixed ammunition can be fired: FRAG-T (fragmentation-tracer) and APC-T (armour piercing capped-tracer). The former is used mainly against aerial targets while the latter, which will penetrate 96 mm (3.7 in) of armour at a range of 1000 m (1,094 yards), is used against ground targets such as tanks and APCs. Effective anti-aircraft range is 4000 m (4,375 yards) with maximum vertical range 8800 m (28,870 ft). Maximum horizontal range is 12000 m (13,125 yards), although fire control would be a major problem at such long ranges.

Specification
ZSU-57-2
Crew: 6
Weight: 28100 kg (61,949 lb)
Dimensions: length 8.48 m (27 ft 10 in); length (hull) 6.22 m (20 ft 5 in); width 3.27 m (10 ft 9 in); height 2.75 m (9 ft)
Powerplant: one Model V-54 V-12 diesel developing 520 hp (388 kW)
Performance: maximum road speed 50 km/h (31 mph); maximum range 420 km (260 miles); gradient 60 per cent; vertical obstacle 0.80 m (2 ft 7 in); trench 2.70 m (2 ft 8 in)

In the ground support role the ZSU-57-2 (as used by Syria in Lebanon) has proved extremely potent.

USSR

ZSU-23-4 quadruple 23-mm self-propelled AA gun



Seeing extensive operational use in Vietnam and the Middle East, the ZSU-23-4 (called 'Shilka' in Soviet service) proved one of the most effective air defence weapons of the 1970s. The four-barrelled weapon can provide radar-directed fire in bursts of up to 50 rounds at a time.

The **ZSU-23-4** was developed in the 1960s as the replacement for the 57-mm ZSU-57-2 self-propelled anti-aircraft gun system. Although the ZSU-23-4's 23-mm cannon has a shorter range than the earlier weapon, the system is much more effective as it has a radar fire-control system and a much higher rate of fire. Since being introduced into the Soviet army on a large scale it has also been exported to almost every country that has received Soviet military equipment, including Afghanistan, Algeria, Angola, Bulgaria, Cuba, Czechoslovakia, East Germany, Egypt, Ethiopia, Hungary, India, Iran, Iraq, Jordan, Libya, Mozambique, Nigeria, North Korea, North Yemen, Peru, Poland, Romania, Somalia, South Yemen, Syria, Vietnam and Yugoslavia. In addition to seeing extensive action during the conflict in Vietnam, the ZSU-23-4 also proved to be one of the most effective systems during the 1973 Middle East war: Soviet-supplied missiles such as the SA-6 'Gainful' forced Israeli aircraft to fly at low altitude, where they encountered the ZSU-23-4 and the SA-7 man-portable missiles. In the Soviet army, who call the system the Shilka, the ZSU-23-4 is issued on the scale of 16 systems per division and normally operates in pairs.

The chassis of the ZSU-23-4 is very similar to that of the SA-6 'Gainful' SAM system, and uses automotive components of the PT-76 amphibious light tank family. It is of all-welded steel construction with a maximum thickness of 15 mm (0.6 in) at the front and 10 mm (0.4 in) over the remainder of the vehicle including the turret, and this provides protection only against small arms fire and shell splinters. The driver is seated at the front of the hull on the left, with the turret in the centre, and engine and transmission at the rear. Suspension is of the torsion-bar type and consists of six single rubber-tyred road wheels with the drive sprocket at the rear and idler at the front. A gas turbine is installed in the rear to provide power for the turret and other systems while the main engine is not running.

The commander, search radar operator/gunner and rangefinding number are all seated in the large flat turret. Main armament consists of four AZP-23 23-mm gas-operated cannon with a cyclic rate of fire of 800 to 1000 rounds per minute per barrel. These weapons have an elevation of +85° and a depression of −4° in a turret capable of traversing through 360°. Turret traverse and weapon elevation are powered, manual controls being provided for emergency use. The gunner can select 3/5-, 5/10- or 50-round bursts, and the cannon have an effective anti-aircraft range of 2500 m (2,735 yards) and a similar range in the ground-target role. Each cannon is provided with 500 rounds of ready-use ammunition; the two types normally fired are API-T (armoured-piercing incendiary-tracer) and HEI-T (high explosive incendiary-tracer). The ZSU-23-4 is fitted with a fire-control system that includes a radar scanner mounted on the turret rear, sights and a fire-control computer. Target can be engaged while the vehicle is travelling across country, but where possible the ZSU-23-4 would stop to provide a more stable firing platform.

Specification

ZSU-23-4

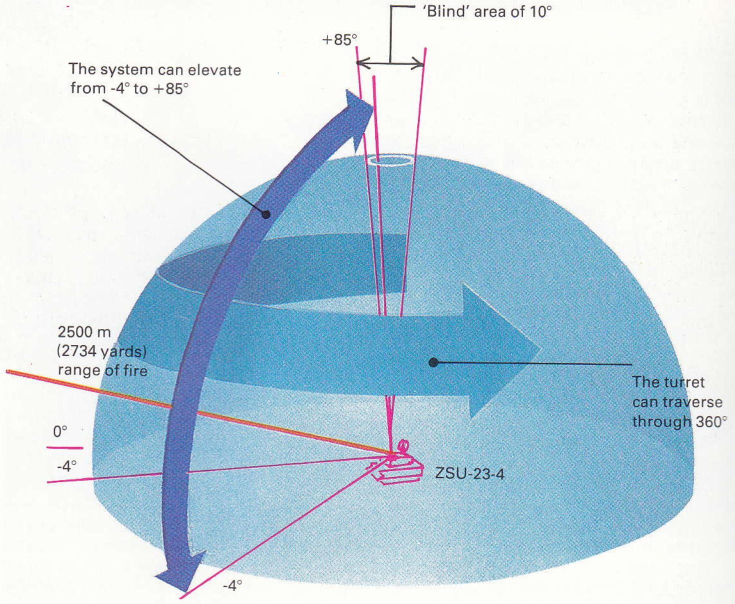
Crew: 4

Weight: 19000 kg (41,888 lb)

Dimensions: length 6.54 m (21 ft 5 in); width 2.95 m (9 ft 8 in); height (without radar) 2.25 m (7 ft 4 in)

Powerplant: one V-6R diesel developing 280 hp (210 kW)

Performance: maximum road speed 44 km/h (27 mph); maximum road range 260 km (162 miles); gradient 60 per cent; vertical obstacle 1.10 m (3 ft 7 in); trench 2.80 m (9 ft 2 in)


'Blind' area of 10°
+85°
The system can elevate from -4° to +85°
2500 m (2734 yards) range of fire
The turret can traverse through 360°
0°
-4°
ZSU-23-4
-4°

The ZSU-23-4 can throw up a wall of impenetrable fire covering a hemisphere of 2500 m (2,734 yards) around itself. Its radar can pick up targets 20 km (12 miles) out, and its computer automatically bears the guns onto the hapless intruder. Able to quickly traverse through 360° and elevate from −4° to +85°, the system can kill anything that enters its zone.

ZSU-23-4s are seen in Egyptian service prior to the 1973 war with Israel. In combination with the SA-6 'Gainful' missile system, the guns wrought havoc for a time amongst Israeli ground attack aircraft.

Soviet 'Shilkas' on the move, with armament and radar systems at the ready. The Soviet army normally operates the weapons in pairs, with some 16 systems being the normal complement per division.

The SPAAG in Vietnam

The Vietnam war saw extensive utilization of self-propelled anti-aircraft systems on both sides of the demilitarized zone. In the south, US forces met no air opposition, which meant operations in the secondary ground support role. On the other hand, North Vietnam was the target for massive American air operations, with the resulting development of the most extensive air defences the world has seen.

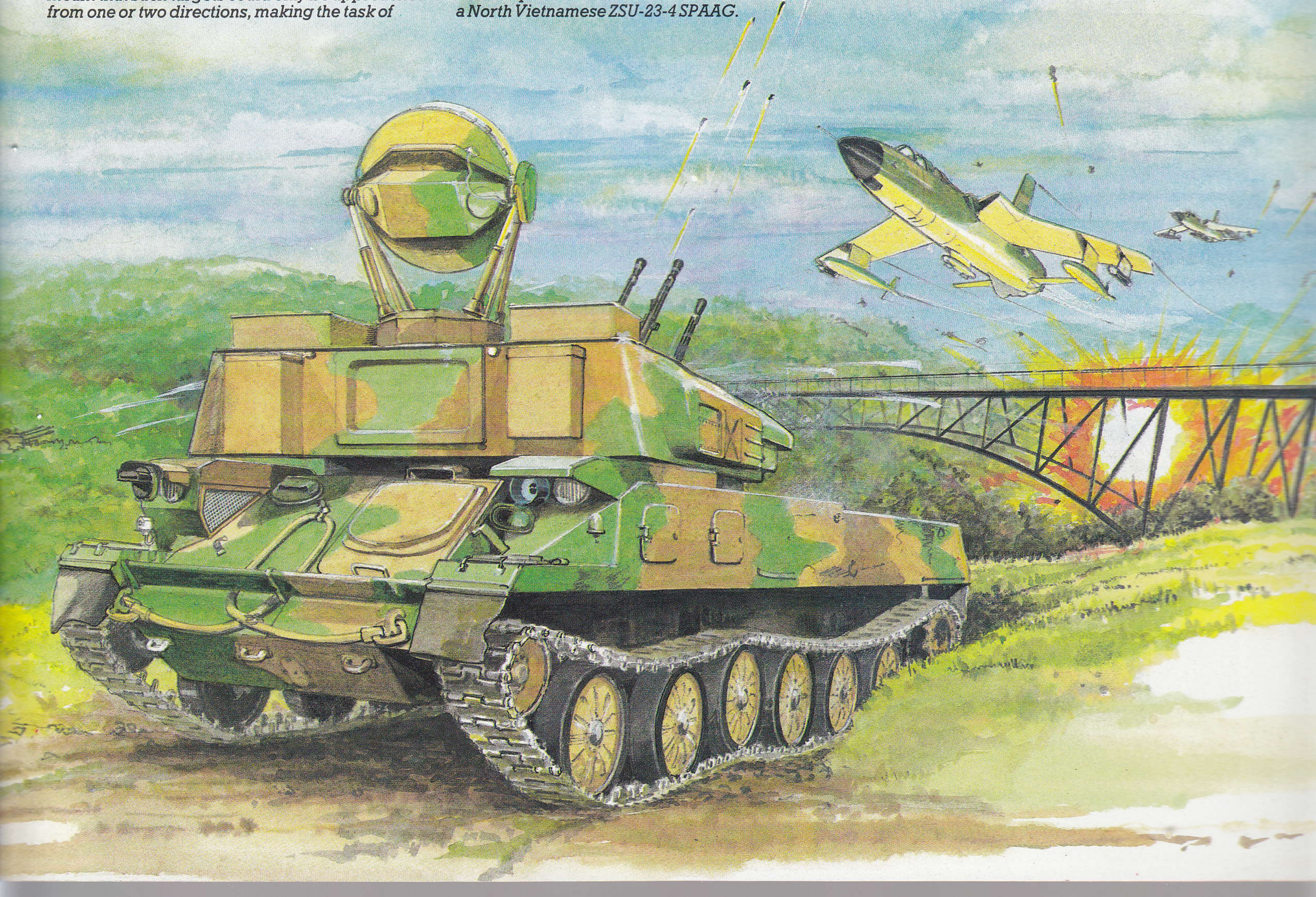
To defend its key air bases and other vital installations against anticipated attacks from the North Vietnamese air force, the United States deployed HAWK surface-to-air missile battalions and anti-aircraft guns to South Vietnam. The first Hawks arrived in 1965 but were withdrawn in 1969 without engaging a single aircraft as the North Vietnamese air force never ventured south. The anti-aircraft guns were the M42 (commonly known as the Duster) and the M55 12.75-mm (0.5-in) quadruple towed anti-aircraft machine-gun system that was first fielded in 1943! Both of these systems were taken back from the National Guard for issue to new regular 'automatic weapon' battalions that were hurriedly trained at Fort Bliss in Texas. A total of three such battalions served in South Vietnam, the first of these being the 1st Battalion, 44th Artillery which arrived in November 1966 and left in 1971; the 4th Battalion, 60th Artillery arrived in March 1967 and left in December 1971; and the 5th Battalion, 2nd Artillery arrived in November 1966 and left in mid-1971. Each battalion had almost 1,000 officers and men, and comprised a battalion headquarters, four M42 batteries, one M55 machine-gun battery (attached) and a searchlight battery (attached). Each battery of M42s had a battery headquarters and two firing platoons. They were trained in Texas only for the air-defence role, but as the threat from the North Vietnamese air force never materialized, thanks to complete US air superiority over the whole of South Vietnam (and much of North Vietnam as well), they were soon assigned to the ground-defence role. For this role the battalions had to work out new tactics as they went along, for no such doctrine had been previously worked out in the United States. When originally deployed to South Vietnam, air-defence weapons came under the field artillery but in 1968 were separated as the Air Defence Artillery, remaining so in 1984.

M42 Duster twin 40-mm SPAAGs were used in two main roles, namely convoy escort and static defence/sweeps around bases and airfields. In the former role, for example on the infamous Highway One (the 'Street Without Joy'), a typical convoy would have two M42s, the lead vehicle tasked to cover the left side of the road and the rear vehicle to cover the right. On many roads in Vietnam trees and vegetation were cleared back as far as possible so that the Viet Cong could not spring an ambush from very close range. In a typical ambush situation the Dusters would pull off the road to engage the enemy while the trucks and other vehicles they were protecting escaped the ambush. Often the Viet Cong would knock out the lead and tail end vehicles, making the escape of the remaining vehicles difficult until the road was cleared. Mines were also a major problem, and many roads had to be swept by combat engineers before the convoys with their high-priority cargoes could even start their trips.

There was insufficient stowage space on the M42 Duster for the personal kit of the six-man crew so many vehicles towed a trailer which carried the rations, additional ammunition and the countless other items of equipment that troops need when operating away from their normal bases. In most cases the Dusters were attached to other units for operations.

The Duster carried a total of 480 rounds of 40-mm ammunition in clips, most of these being stowed in ammunition containers along the top of each track guard. The four types of ammunition available were AP-T (armour piercing-tracer), HE-T (high explosive-tracer), HEI-T (high explosive incendiary-tracer) and prac-

Primary targets for USAF operations in Vietnam were the railways, roads and bridges carrying supplies and munitions to the Ho Chi Minh trail. The mountainous terrain of much of Vietnam meant that such targets could only be approached from one or two directions, making the task of defenders much simpler. Until the introduction of 'smart' weapons late in the war, attacks often meant running a gauntlet of fire, and losses in the aircraft making low-level attacks. Here a pair of USAF Republic F-105 Thunderchiefs take fire from a North Vietnamese ZSU-23-4 SPAAG.



tice. In the ground-ground role the maximum listed range of the Duster was listed as 9475 m (10,362 yards), although observation would be a major problem at such ranges. The preferred round in Vietnam was the HEI-T which was deadly against troops in the open or against field fortifications. The gunner would select single shots or full automatic fire; a practical rate of fire was 120 rounds per barrel per minute but, as the maintenance of such a rate meant that the ammunition supply would last only two minutes, short bursts or even single shots were normally the order of the day. The turret of the M42 Duster was open at the top, sides and rear, so the crew were very vulnerable to small arms fire and shell fragments.

Many Dusters carried culvert halves, chain-link fencing, stakes and empty sandbags in the trailer for use when the vehicle was static for any period of time, eg at night. The culvert halves would be unloaded and covered with filled sandbags to provide the crew with protection against mortar attack; and the stakes would be positioned a short distance in front of the vehicle with the chain-link fencing attached to provide protection against the Soviet-supplied RPG-7 rocket-propelled grenades, whose HEAT warheads would thus be detonated by the fence while still well away from the actual vehicle. Chain-link fences and stakes were also carried by tanks and armoured personnel carriers in Vietnam. In addition to being armed with twin 40-mm guns the Duster was also fitted with a 7.62-mm (0.3-in) machine-gun for local defence, and in Vietnam this was often provided with a shield to give at least a measure of protection to the exposed gunner. All crew members also had 5.56-mm (0.22-in) M16 rifles for personal defence, and these small-calibre weapons were in constant use as the Viet Cong often came so close that the 40-mm weapons could not be used.

When a camp or base was under mortar attack the infantry would take cover in bunkers while the camp's own artillery (105-mm/4.13-in or 155-mm/6.1-in howitzers), mortars and Dusters returned the fire, assuming that they knew the location of the enemy by radar or the flashes of the weapons as they were fired. The mortar attack would often be followed by a sapper or infantry attack. The latter were small groups of Viet Cong who would work their way through the perimeter minefields and wire entanglements during the mortar barrage, carrying satchel charges which would then be thrown or placed near bunkers or other vital targets, or in the wire entanglements to clear a way for the following infantry

Small-arms retaliation

When possible the Dusters were sited in hull-down positions when being used in the static role, with only their turret showing, and nearby would be bunkers for the crew and additional ammunition. Once the Dusters started firing their positions were fairly easily detected by the enemy as they fired tracer ammunition, and they would then be subjected to a concentration of small arms fire which sometimes had a deadly effect on the crew as they were provided with so little protection. The Duster often moved around the base during a Viet Cong attack to stiffen up the defence at weak points, as well as to confuse the enemy on its exact position. Another tactic used by Duster crews was to move the vehicle after dark as during the daylight hours its position had probably been fixed by the enemy.

The quadruple 12.7-mm (0.5-in) system was often mounted on the rear of 2½-ton 6×6 trucks and fitted with additional armour protection for the mount as well as the vehicle's cab, and used for convoy escort in a manner similar to the Duster. Although the M55 had a much shorter range than the Duster this was not a great drawback in the convoy escort role as most engagements took place at very short ranges. Each of the 12.7-mm (0.5-in) M2 HB machine-guns of the M55 was provided with a magazine holding 210 rounds of ammunition, and turret traverse and weapon elevation were electric, with manual controls for emergency use. Each barrel had a cyclic rate of fire of 450/550 rounds per minute, but the practical rate of fire was 150 rounds per minute. Other M55s were used in the static defence role and airlifted into isolated batteries and camps that could not be reached by roads, while others were fitted on barges and used on the Mekong Delta and other waterways which cross much of South Vietnam and were frequently used by the enemy. It is interesting to note that the Soviet army has fitted 23-mm ZU-23 towed anti-aircraft guns on the back of trucks for use in the convoy escort role in Afghanistan in a manner similar to that pioneered by the US Army in Vietnam. There is also some evidence that the ZSU-23-4 has seen action in the ground-support role in Afghanistan.

The M163 Vulcan self-propelled anti-aircraft gun was first deployed to Vietnam late in 1968 for use in the ground-support role. The original intention was for the team, which consisted of five Vulcans plus 23 officers and men of the 1st Vulcan Combat Team, to undertake an evaluation to have been completed by March 1969, but in the end the team stayed until May 1969 as it was used in the mopping-up operations following the Tet Offensive of 1968. The five Vulcans were used mainly for convoy escort, and were probably more effective in this role than the Duster as they had greater firepower for close-range work and were less easy for the Viet Cong to pick out of a convoy of trucks, jeeps and M113s, for the Vulcan was very similar in appearance to the M113 Armoured Cavalry Assault Vehicle (ACAV) which had a 12.7-mm (0.5-in) machine-gun and two 7.62-mm (0.3-in) machine-guns. In one action six ACAVs and one Vulcan were clearing a road ahead of a convoy near Saigon when they were ambushed. Within the first 15 seconds of the ambush five of the ACAVs were hit and the road blocked. The Vulcan was the only vehicle able to return fire and soon it was off the road getting round the knocked-out ACAVs so that it could return fire. It first fired a burst of 30 rounds from its six-barrelled Vulcan 20-mm cannon, but then the gunner switched to 10-round bursts to conserve ammunition, for although the system carries a total of 2,100 rounds of ammunition only 1,100 of these are for ready use. By this time an urgent radio message had been sent and soon reinforcements were on the way. The Vulcan kept the Viet Cong occupied as a defensive line was formed and machine-guns were taken from the damaged vehicles. Within 30 minutes the relief force, which included tanks and another Vulcan, were on the scene, but the battle went on for another three hours. When it was over, more than 40 Viet Cong bodies were found.

By the time the final Dusters and M55s had been pulled out of Vietnam and returned to the USA, the former had fired some 4 million rounds of 40-mm ammunition while the latter had fired some 10 million rounds of 12.7-mm (0.5-in) ammunition. The M55 has now been withdrawn from the US Army, although in 1984 some eight National Guard battalions, each with 36 Dusters, are still training and earmarked for overseas deployment in time of war. There is little doubt that the presence of

M42 twin 40-mm Dusters were already in Asia, based on Okinawa, when American involvement in Vietnam led to their redeployment. The lack of air opposition saw M42s in static fire support roles, or on the road as convoy protection.

Dusters, Vulcans and M55s in many situations saved allied forces from heavy casualties and even being overrun by the Viet Cong.

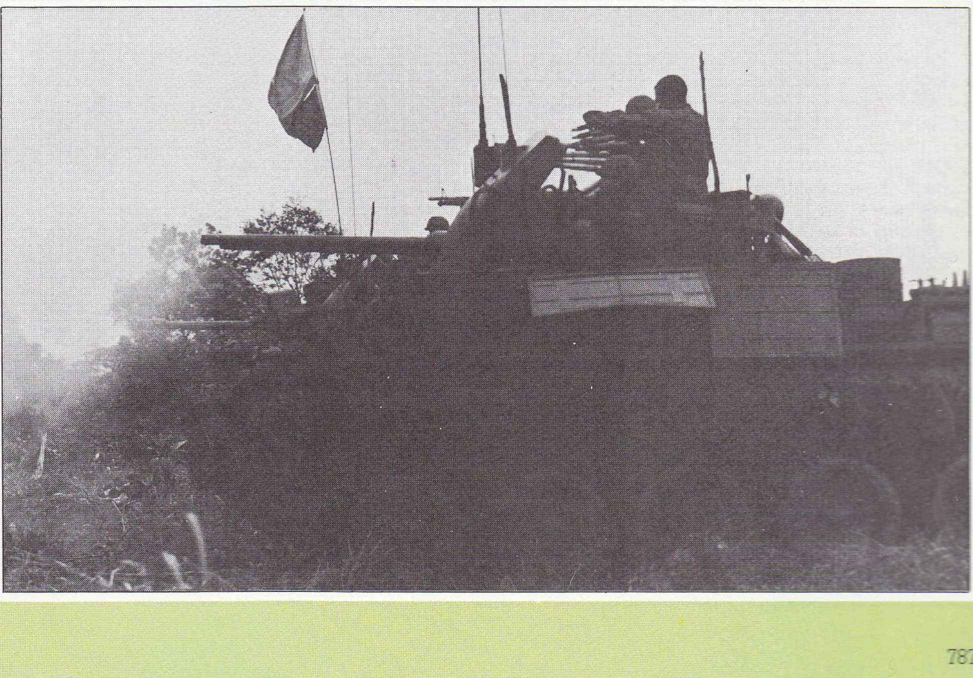
During World War II both Allied and German artillery units, including self-propelled weapons, were often used in the ground-support role. Israel has used its 20-mm Vulcan SPAAGs and TCM-20 SPAAGs in the ground-support role, while Syria is known to have used the ZSU-57-2 in a similar role in the Lebanon.

North Vietnam

The air defences of North Vietnam in the 1960s were probably the most dense in the world has ever seen, with both anti-aircraft guns and SAMs widely deployed. The higher-altitude SA-2 'Guideline' SAM forced American aircraft to fly much lower than they wished, at altitudes at which they could be engaged by the anti-aircraft guns, some them optically-controlled and others radar-controlled. Anti-aircraft guns ranging from 12.7-mm (0.5-in) and 14.5-mm (0.57-mm) machine-guns up to the massive 130-mm (5.12-in) KS-30 anti-aircraft gun were used. As far as it is known only three self-propelled anti-aircraft guns were used: the Chinese 37-mm Type 63, and the Soviet 57-mm ZSU-57-2 and 23-mm ZSU-23-4. The two Soviet weapons were kept to the north of the DMZ until the final stages of the war, although the Type 63 is known to have been deployed in South Vietnam as one was captured by the South Vietnamese army. Although North Vietnam had a very dense air-defence system of radars, guns, missiles and fighters, the Americans were still able to make repeated raids without excessive losses in aircraft. For much of the war only strictly military targets were allowed to be hit, and these were often factories or bridges that could only be approached from fixed directions, which made the positioning of anti-aircraft guns an easy matter. For most of the war aircraft dropped conventional bombs, and it was not until the final stages of American involvement that the first of laser-guided bombs started to make their appearance. These latter made a dramatic impact as the attacking aircraft could stand off out of range of the anti-aircraft guns and launch the missile with a high probability of a first-round hit. Stand-off weapons are now in service with a number of air forces around the world, and have complicated the defence of static targets even more as the anti-aircraft systems (gun or missile) must shoot down the aircraft before it is in a position to launch its missile.

M163 Vulcans first appeared in Vietnam in 1968, where their massive short-range firepower was shown to advantage in dealing with Viet Cong ambushers. Their first major operation came during the mopping-up after the 1968 Tet offensive.

August 1967, and M42s of the 60th Artillery are in action on the Cambodian border. The 40-mm HEI-T (High-Explosive Incendiary Tracer) shells were deadly against troops in the open or against field fortifications.

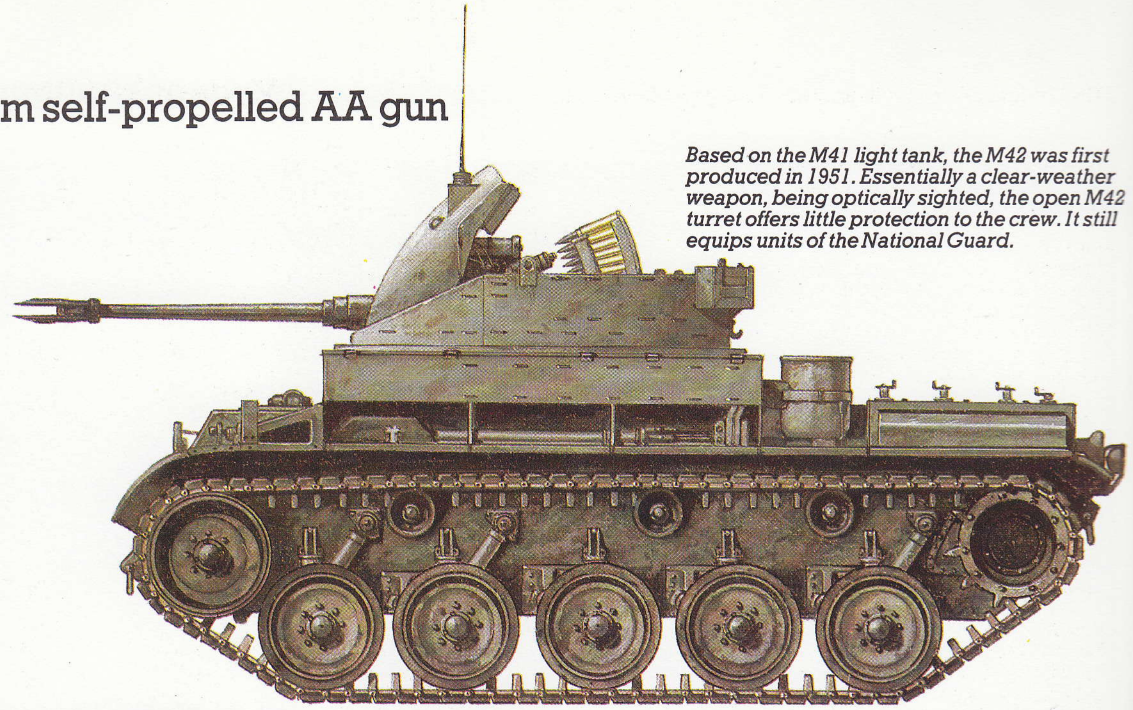


USA

M42 twin 40-mm self-propelled AA gun

During the latter half of World War II the United States developed a series of tracked vehicles (the Light Combat Team) which included the M24 Chaffee light tank, M37 105-mm (4.13-in) howitzer motor carriage, M41 155-mm (6.1-in) howitzer motor carriage and M19 twin 40-mm self-propelled anti-aircraft gun system. After the end of the war a new family of light vehicles was developed, this including a light tank called the M41 (or Walker Bulldog) while the anti-aircraft gun system, which had the same automotive components but a different hull, was called the **M42**, or more commonly the **Duster**. The turret of the M42 is the same as that of the earlier M19, though in the former it is mounted in the centre of the hull and in the latter at the rear of the hull. The M42, whose development designation was **T141**, was in production from 1951 to 1956 and about 3,700 equipments were built, the majority by the Cadillac Motor Car Division of the General Motors Corporation at the Cleveland Tank Plant. Late production equipments were called the **M42A1**, the major difference being the fuel injection system for the engine. One of the main drawbacks of the M42, along with other members of this family, was its use of a petrol engine, which resulted in a very short operating range. Today the M42 is still used by the US Army National Guard (eight battalions), as well as by Austria, Greece, Japan, Jordan, Lebanon, Saudi Arabia, Taiwan, Thailand, Turkey and Venezuela. It was used successfully in Vietnam by both the US and South Vietnamese armies, although its primary role was in the ground-support fire role rather than the air-defence role for which it was originally designed.

The hull and turret of the M42 are of all-welded steel construction, with the commander and driver seated in the front of the vehicle, turret with other four crew members located in the centre, and the engine and transmission installed at the rear. Suspension is of the well-tried torsion-bar type, and consists of five dual rubber-tyred road wheels, with the drive sprocket at the rear and idler at the front; there are three track-return rollers.



Based on the M41 light tank, the M42 was first produced in 1951. Essentially a clear-weather weapon, being optically sighted, the open M42 turret offers little protection to the crew. It still equips units of the National Guard.

Right: M42A1 vehicles wait on the range firing line at Dina Beach in the Panama Canal Zone. By 1967, when the photograph was taken, the Dusters were nearing the end of their front-line service, although still being used operationally in Vietnam.

The turret and weapons are power-operated; the turret can be traversed through 360° at 40° per second, and the guns can be elevated from $-3°$ to $+85°$ at a speed of 25° per second. Manual controls are provided for emergency use. A total of 480 rounds of ammunition is carried, and the guns have a practical rate of fire of 120 rounds per minute per barrel with an effective anti-aircraft range of 5000 m (5,470 yards). The gunner can select single shots or full automatic fire, and four types of ammunition carried are AP-T, HE-T, HEI-T and TP-T. A 7.62-mm (0.3-in) M60 or M1919A4 machine-gun is mounted externally on left rear of turret for local defence, and 1,750 rounds of ammunition are carried for this weapon.

The M42 is essentially a clear-weather system as its fire-control system consist of an M38 computing sight, M24c reflex sight and a speed ring sight. Efforts were made to fit a radar fire-control system, but this idea was eventually dropped.

Specification

M42
Crew: 6
Weight: 22452 kg (49,497 lb)
Dimensions: length (guns forward) 6.356 m (20 ft 10 in); length (hull) 5.819 m (19 ft 1 in); width 3.225 m (10 ft 7 in); height 2.847 m (9 ft 4 in)
Powerplant: one Continental AOS-895-3 6-cylinder air-cooled petrol engine developing 500 bhp (373 kW)
Performance: maximum road speed 72.4 km/h (45 mph); maximum range 161 km (100 miles); gradient 60 per cent; vertical obstacle 0.711 m (2 ft 4 in); trench 1.829 m (6 ft)

USA

M163 Vulcan 20-mm self-propelled AA gun

In the early 1960s Rock Island Arsenal developed two 20-mm Vulcan air-defence systems. The self-propelled model was based on a modified M113 APC chassis and was designated the **XM163** (the chassis being the XM741) while the towed model was the XM167. These were subsequently accepted for service as the **M163** and M167 respectively. The former was produced by the General Electric Company of Burlington, Vermont, and was soon deployed to South Vietnam where it was widely used in the ground fire-support role. In the US Army the M163 is deployed in composite battalions, each of which has two batteries each with 12 Chaparral SAM launchers and two batteries each with 12 M163s. The towed M167 is used mainly by the air-mobile and air-assault divisions. In addition to the United States, the M163 is also used by Ecuador, Israel, Morocco, North Yemen, South Korea and Tunisia. In the regular US Army the M163 will be replaced by the M247 DIVAD, then being passed on to the National Guard, which at present operates the old twin 40-mm M42 self-propelled anti-aircraft gun system.

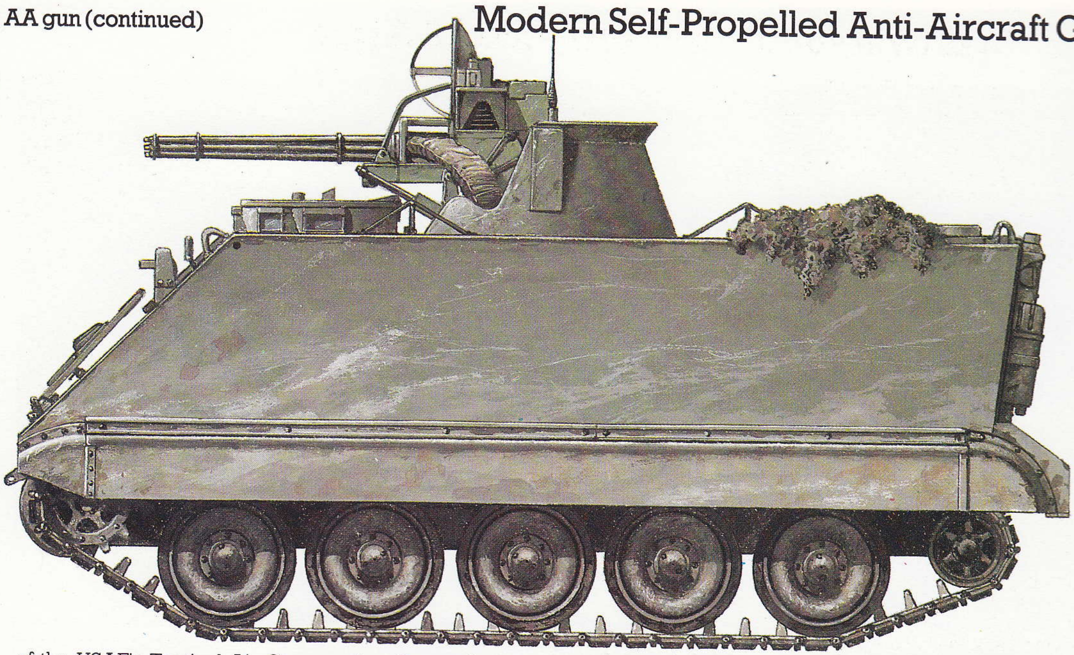
The M163 consists of a standard M113 chassis on top of which has been mounted an electrically-operated turret fitted with a 20-mm six-barrelled M61 series cannon, a US Navy Mk 20 lead-computing sight, and an EMTECH range-only radar located on the right side of the turret. The turret can be traversed through 360° at a speed of 60° per second and the gun elevated from $-5°$ to $+80°$ at 45° per second. Manual controls are provided in case of power failure. The 20-mm cannon, which is a development of the weapon originally designed for the Lockheed F-104 Starfighter in the

Standard anti-aircraft gun in US Army service, the Vulcan is available in tracked self-propelled (M163) and wheeled towed (M167) forms.

M163 Vulcan 20-mm self-propelled AA gun (continued)

1950s and still fitted in aircraft such as the General Dynamics F-16, has two rates of fire in this application, 1,000 and 3,000 rounds per minute. The former is normally used for engagement of ground targets, while the higher rate of fire is used against aerial targets. The gunner can select 10-, 30-, 60- or 100-round bursts, and 1,100 rounds of ready-use ammunition are carried, with a further 1,000 rounds in reserve. Ammunition types that can be fired include APT (armour piercing tracer), TP (target practice), HEI (high explosive incendiary), TPT (target practice tracer) and HEI-T (high explosive incendiary-tracer). All have a muzzle velocity of 1030 m (3,380 ft) per second. Maximum effective range in the anti-aircraft role is 1600 m (1,750 yards) and in the ground role 3000 m (3,280 yards). A typical target engagement is described in the entry for the Vulcan Commando air-defence system, which has been developed specifically for the export market.

The US Air Force has a requirement for a Mobile Weapon System (MWS) to defend its airfields against ground attack from helicopters, and General Electric has recently been awarded a contract for a MWS which will consist of a M113A1 chassis fitted with a power-operated turret armed with a 30-mm GAU-8 cannon which would have ammunition interoperability with the Fairchild A-10A Thunderbolt II aircraft of the USAF's Tactical Air Command.



The M163 consists of a 20-mm Gatling-type cannon mounted upon an M113 APC chassis. The gunner can select rates of fire of 1,000 or 3,000 rounds per minute for use with ground or airborne targets, and he can select bursts of 10, 30, 60 or 100 rounds. Maximum effective anti-aircraft range is 1600 m (1,750 yards).

Specification

M163

Crew: 4

Weight: 12310 kg (27,139 lb)

Dimensions: length 4.86 m (15 ft 11 in); width 2.85 m (9 ft 4 in); height (overall) 2.736 m (8 ft 11 in); height (hull top) 1.83 m (6 ft 0 in)

Powerplant: one Detroit Diesel 6V-53 6-cylinder diesel developing 215 bhp (160 kW)

Performance: maximum road speed 67 km/h (42 mph); maximum range 483 km (300 miles); gradient 60 per cent; vertical obstacle 0.61 m (2 ft 0 in); trench 1.68 m (5 ft 6 in)

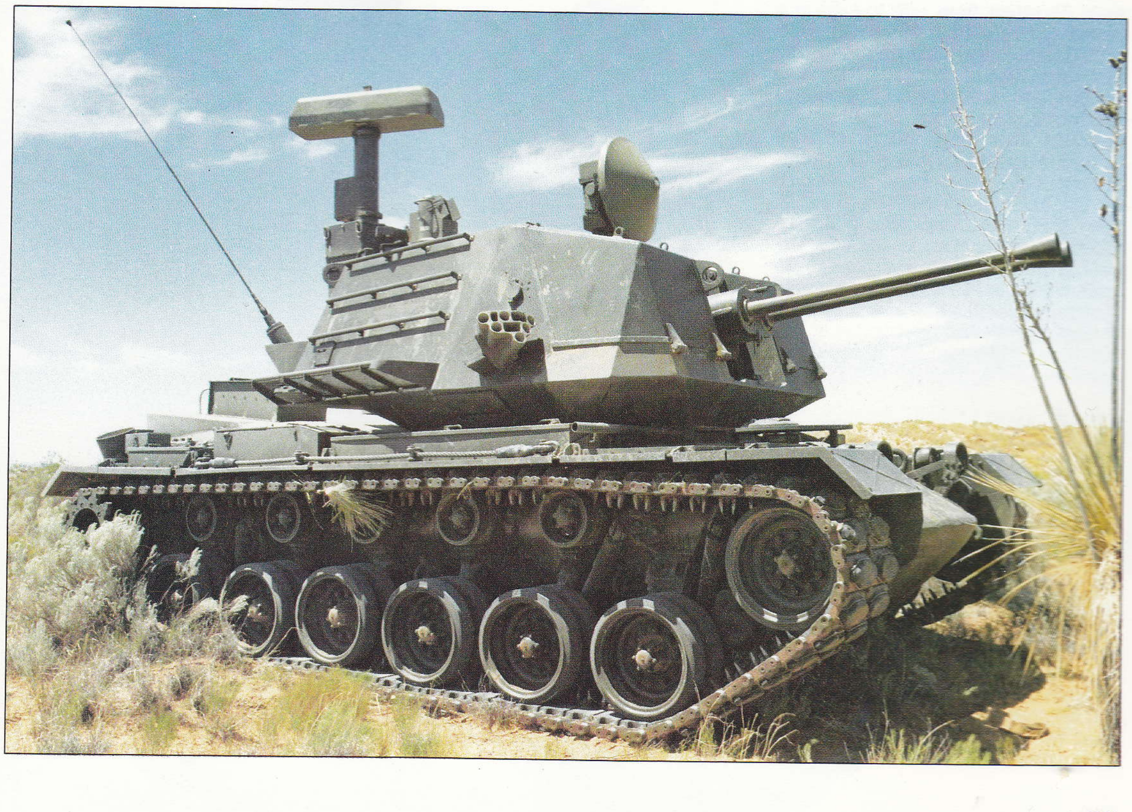
USA

M247 Sgt York twin 40-mm self-propelled AA gun

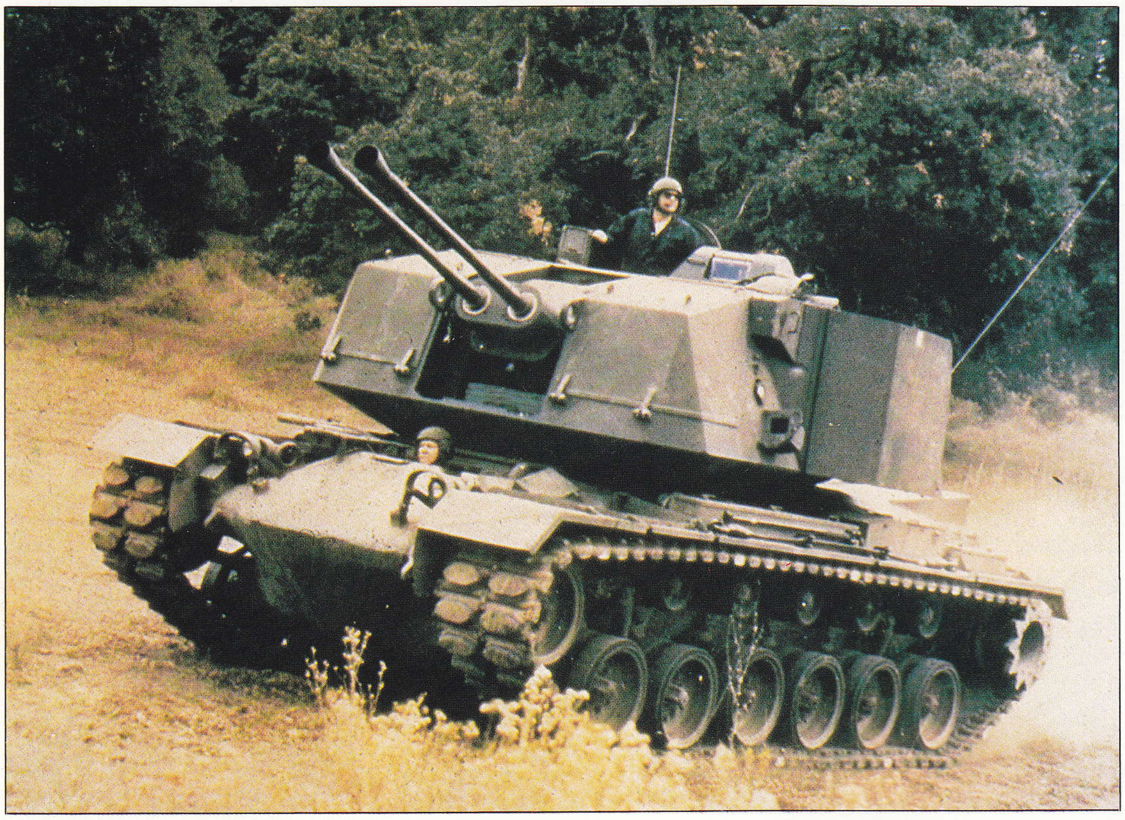
Since the late 1960s the only self-propelled anti-aircraft gun system in front line service with the US Army has been the M163 20-mm Vulcan system, which has relatively short range and is not considered to be very accurate. In January 1978, after studying a number of proposals from industry, the United States Armament Research and Development Command issued two competitive contracts for the development of a self-propelled anti-aircraft gun system on a modified M48A5 tank chassis under the designation Division Air Defense Gun (DIVAD) system. General Dynamics, Pomona Division, entered a system that used twin 35-mm Oerlikon cannon while Ford Aerospace and Communications Corporation entered a system that used twin 40-mm L/70 Bofors guns. In the towed configuration some of the latter were already operated by a number of NATO countries. Both entries in the competition had a comprehensive fire-control system that included both surveillance and tracking radars designed to engage both aircraft and helicopter. Following evaluation of the two systems the Ford Aerospace and Communications model was selected for production in May 1981 and was later designated the **M247 Sgt York**. The US Army has a requirement for a total of 618 systems, which will be issued to anti-aircraft battalions at divisional level. The first production system was completed at the Ford Aerospace and Communications Corporation new DIVAD facility at Newport Beach, California, late in 1983.

As already mentioned the M247 is an M48A5 tank chassis with a new turret mounted in the centre of the hull. The driver is seated at the front of the hull, and the engine and transmission are at the rear. Suspension is of the torsion-bar type, and consists of six dual tubber-tyred wheels, with the idler at the front and drive sprocket at the rear; there are five track-return rollers. Two radars are mounted on the turret, the circular tracking radar on the left and the flat search radar at the rear; both of these can be folded down to reduce the overall height of the vehicle. The gunner is seated on the left of the turret and the commander on the right, each member being provided with a hatch cover. The gunner has a roof-mounted sight incorporating a laser rangefinder, while the commander has a panoramic roof-mounted periscope and fixed periscopes. The fire-control system of DIVAD is fully automatic with manual override.

The M247 Sgt York twin 40-mm self-propelled AA gun is to replace the M163 in service with the US Army. It is mounted on an M48 tank chassis, and so is more suitable for use with the M1 Abrams tank and M2 Bradley fighting vehicle now entering service.



M247 Sgt York twin 40-mm self-propelled AA gun (continued)



***Above:** The twin 40-mm cannon used in the Sgt York are developments of the well proven Swedish Bofors L/70 anti-aircraft gun, already in service in its towed form with several NATO forces. The ammunition developed for the Sgt York includes HEPD (high explosive point detonating) for ground targets and PFPX (pre-fragmented proximity fused) for aerial targets.*

The twin 40-mm cannon have powered elevation from −5° to+85° in a turret capable of traverse through 360°. Each 40-mm gun is provided with its own magazine, and 502 rounds of ammunition are carried. Once this ready-use ammunition has been exhausted new ammunition can be loaded in under 20 minutes. Two types of ammunition have been developed for DIVAD, namely HEPD and PFPX. The HEPD (high explosive point detonating) ammunition is used for engaging ground targets and close-in aircraft, while the PFPX (pre-fragmented proximity fused) ammunition is used against aircraft and helicopters at longer range, and also has a capability against tactical missiles.

Specification

M247 Sgt York

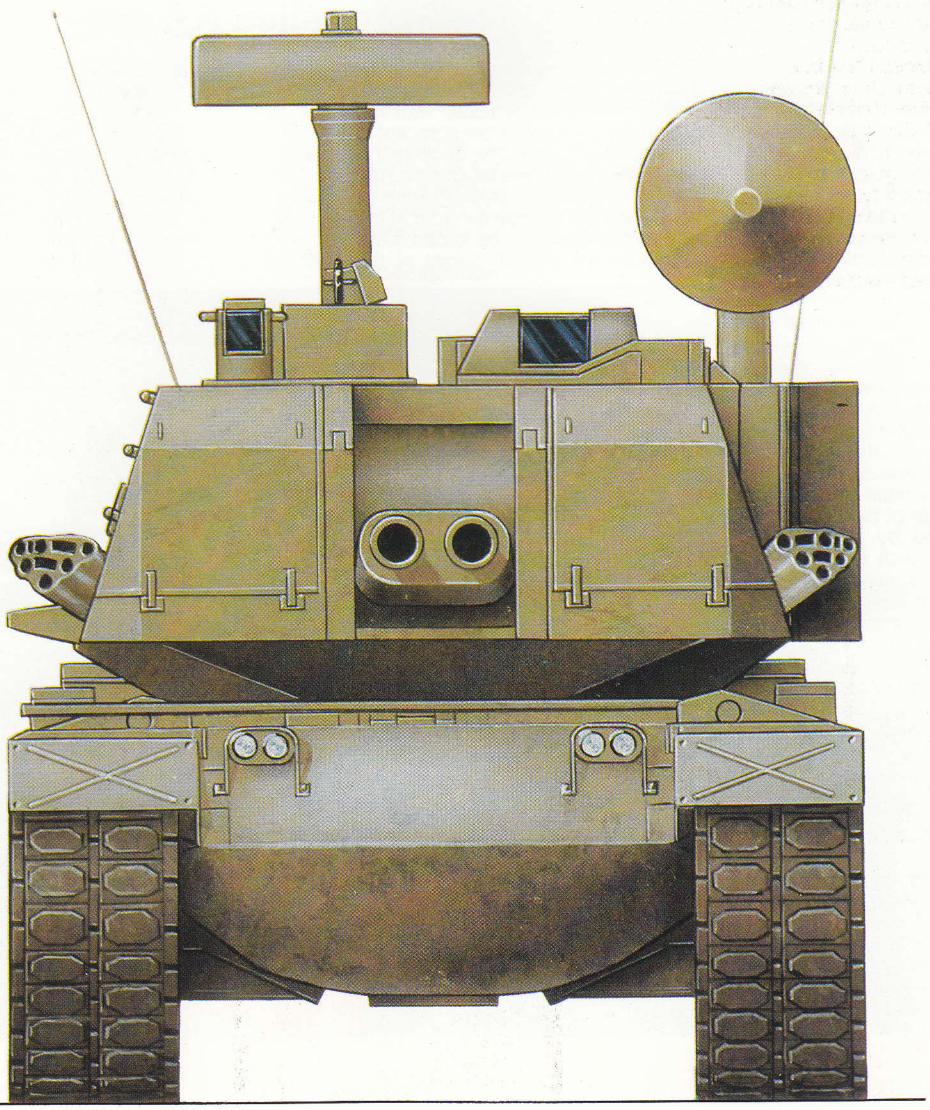
Crew: 3

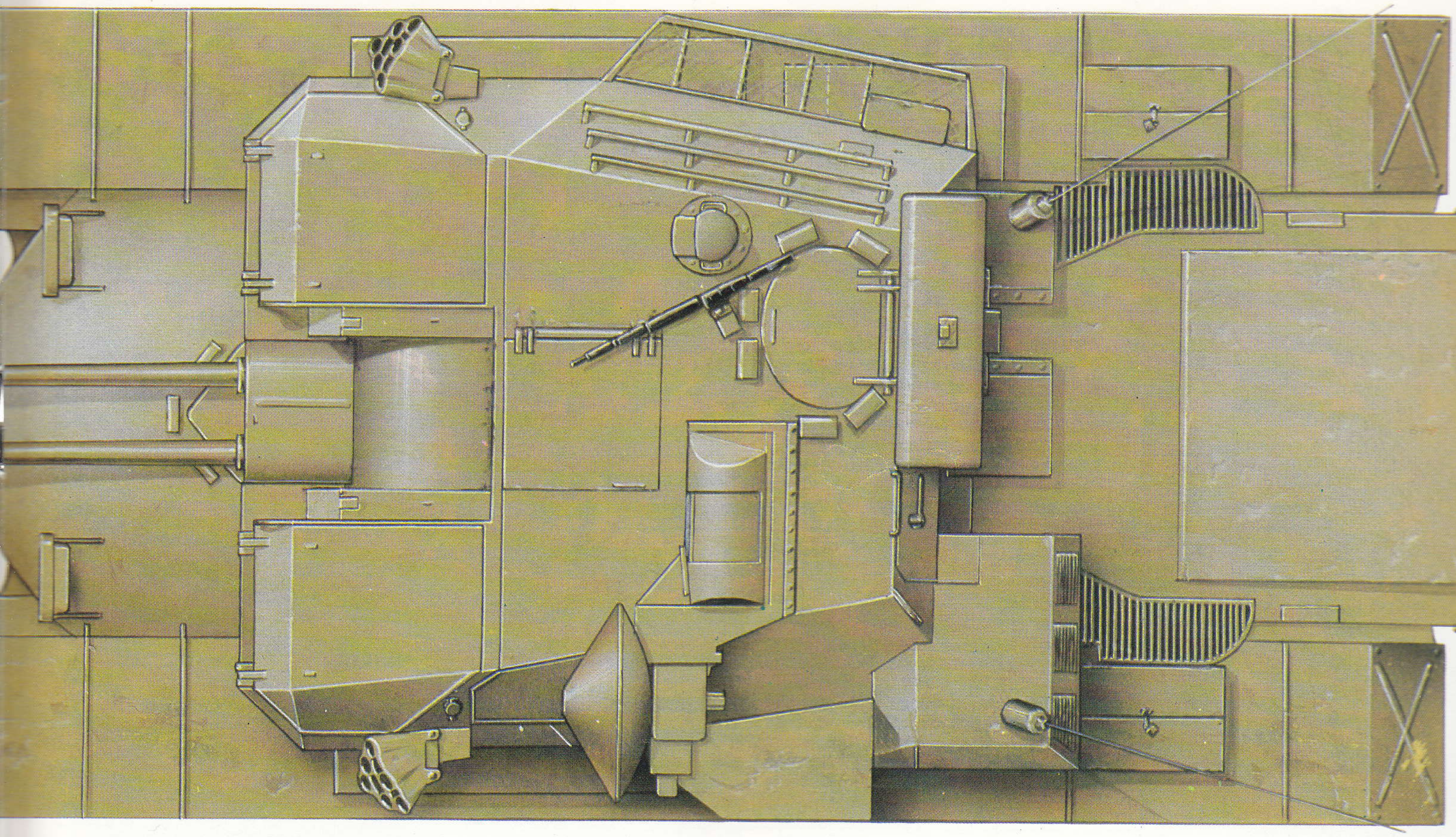
Weight: 54430 kg (119,996 lb)

Dimensions: length 7.674 m (25 ft 2 in); length (hull) 7.123 m (23 ft 4 in); width 3.632 m (11 ft 11 in); height (radar up) 4.611 m (15 ft 2 in); height (roof of turret) 3.419 m (11 ft 3 in)

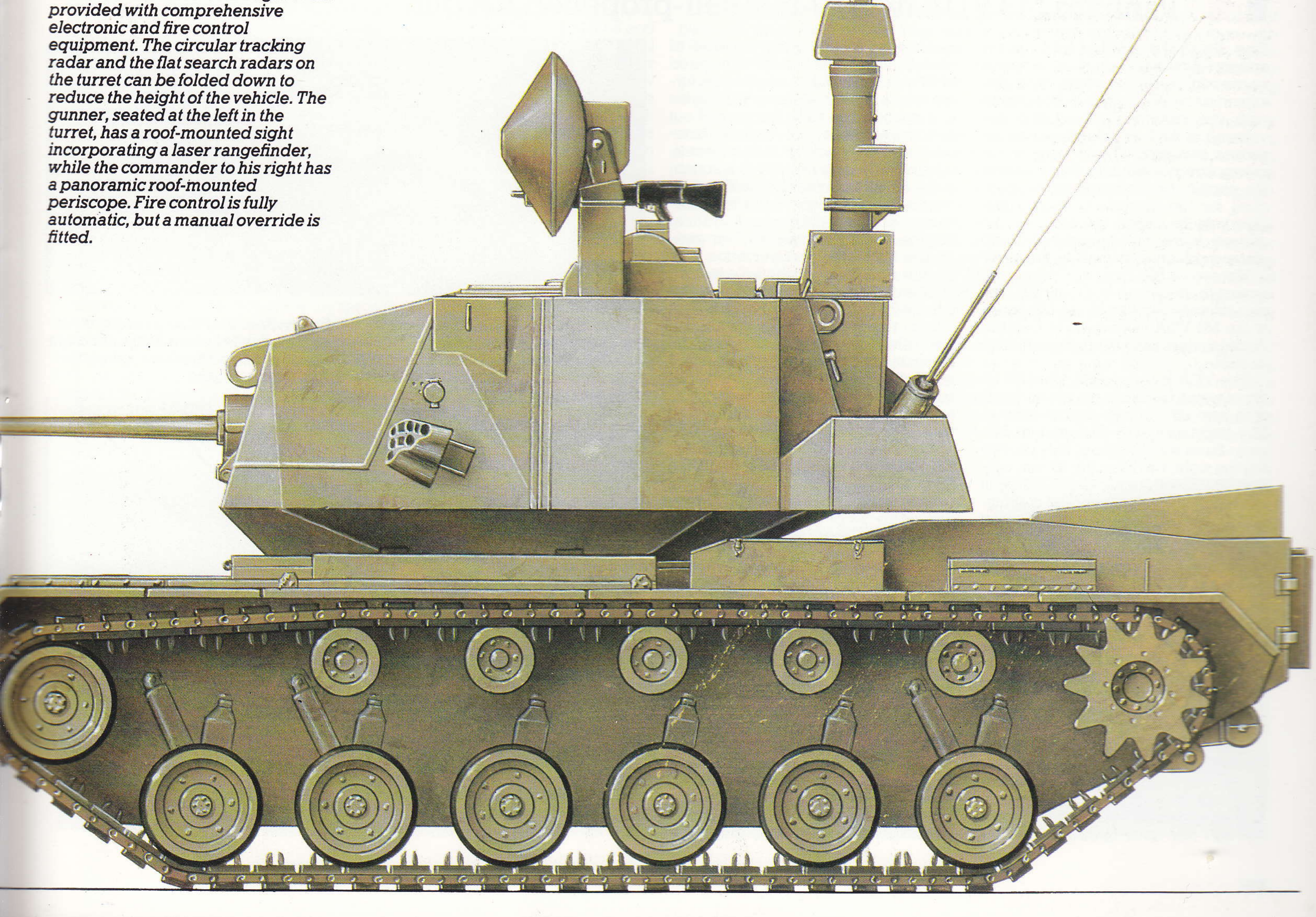
Powerplant: one Teledyne Continental AVDS-1790-2D diesel engine developing 750 hp (559 kW)

Performance: maximum road speed 48 km/h (30 mph); maximum range 500 km (311 miles); gradient 60 per cent; vertical obstacle 0.914 m (3 ft 0 in); trench 2.591 m (8 ft 6 in)





The three-man crew of the Sgt York is provided with comprehensive electronic and fire control equipment. The circular tracking radar and the flat search radars on the turret can be folded down to reduce the height of the vehicle. The gunner, seated at the left in the turret, has a roof-mounted sight incorporating a laser rangefinder, while the commander to his right has a panoramic roof-mounted periscope. Fire control is fully automatic, but a manual override is fitted.



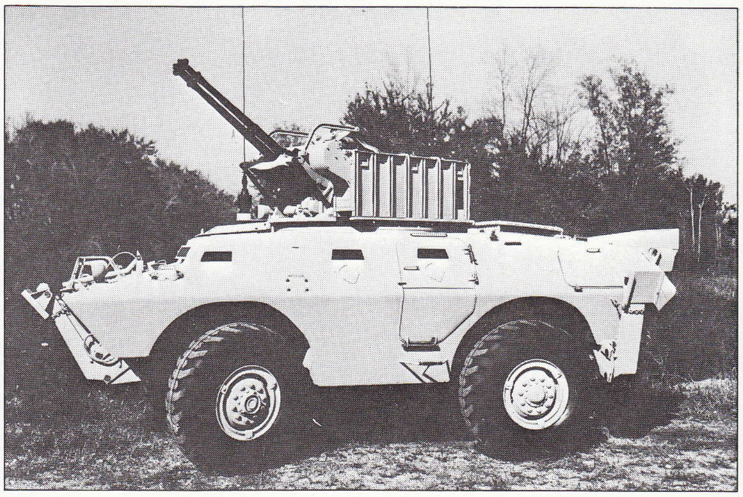
USA

Commando Vulcan 20-mm self-propelled AA gun

While the M163 self-propelled Vulcan air-defence system on the standard M113 chassis satisfied the needs of the US Army, it did not meet the requirements of the Saudi Arabian National Guard (SANG) which operates a huge fleet of Cadillac Gage V-150 (4×4) armoured cars in a variety of versions. As it would create logistical, operational and training problems to integrate a tracked vehicle into a wheeled armoured battalion, General Electric and Cadillac Gage developed a special version of the V-150 to meet the SANG requirements and this **Commando Vulcan** system is now in service. It consists of a standard V-150 (4×4) chassis fitted with the same turret, weapon and associated controls as the M163, which makes training and the provision of spares an easy matter. The vehicle has a four-man crew consisting of the commander, gunner, radio operator and driver. The chassis has been fitted with three hydraulic jacks, one at the front and one on each side of the hull at the rear, which can be lowered to the ground from within the safety of the vehicle to provide a more stable firing platform.

A typical target engagement of the Commando Vulcan or tracked M163 Vulcan air-defence system is as follows. The gunner first observes the target visually, or the system may be tied into a radar that alerts the gunner to the approximate heading and altitude of the target. The gunner then acquires the target in his sight and starts to track the target using the Navy Mk 20 gyro lead-computering gunsight. The I-band pulse-Doppler radar mounted on the right side of the turret is servoed to the optical line of sight and provides target range and range rate data to the sight generator. With other information the sight automatically computes the future position of the target and then adds superelevation required to hit the target. When the target is within range a green light appears in the sight optics, this informing the gunner not only that the radar has acquired the target and is performing its functions but also that the target is within the effective range of the 20-mm cannon, so avoiding the waste of valuable ammunition. When fitted with the Vulcan cannon the system retains its amphibious capability and is propelled in the water by its wheels at a speed of about 4.8 km/h (3 mph).

Another SPAAG developed specifically for the export market was the **Eagle** twin 35-mm system developed in the 1970s to meet the requirements of the Imperial Iranian army for a highly mobile anti-aircraft gun system that would defend strategic targets such as factories and oil installations. It basically consists of a modified M548 tracked carrier fitted with an unmanned twin-gun turret on the hull rear. This has 280 rounds of ready-use ammunition, and the guns each have a cyclic rate of fire of 575 rounds per minute. With the fall of the Shah of Iran the contract was cancelled, although the system is still being offered by ARES for export.



The Commando Vulcan consists of an M163 gun, turret and fire control system mounted on a standard Cadillac Gage V-150 Commando armoured car chassis.

Specification

Crew: 4
Weight: 10206 kg (22,500 lb)
Dimensions: length 5.689 m (18 ft 8in); width 2.26 m (7 ft 5 in); height (overall) 3.302 m (10 ft 10 in)
Powerplant: one Cummins V-8 diesel developing 202 bhp (150 kW)
Performance: maximum road speed 88.54 km/h (55 mph); maximum road range 640 km (400 miles); gradient 60 per cent; vertical obstacle 0.914 m (3 ft 0 in); trench not applicable

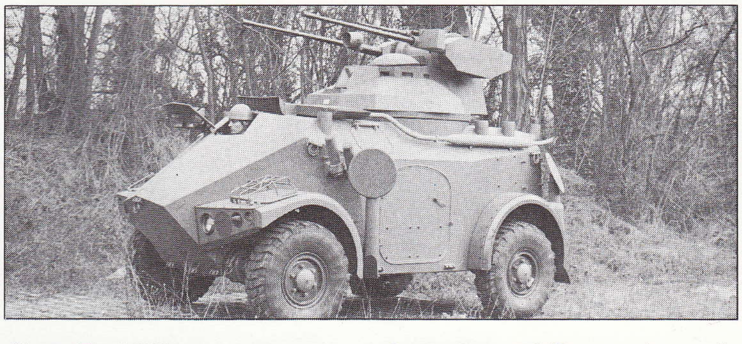
FRANCE

Panhard M3 VDA twin 20-mm self-propelled AA gun

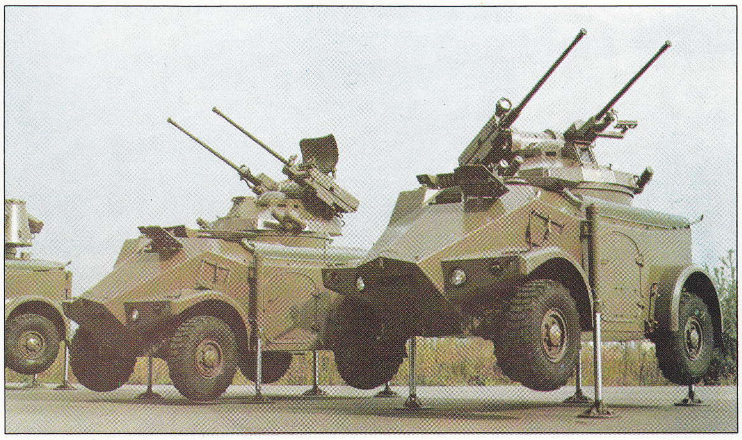
The Panhard AML (4×4) light armoured car has been one of the most successful vehicles of its type designed since World War II. To operate with this vehicle Panhard also developed a 4×4 armoured personnel carrier that uses 95 per cent of the automotive components (for example the engine, transmission and suspension) for the original armoured car. This vehicle, called the M3, has also proved to be highly successful and since production started in the early 1970s over 1,500 have been built for export to more than 30 countries. The anti-aircraft member of the M3 family is the **M3 VDA** (Véhicule de Defense Antiaérienne) and entered production in 1975.

The VDA is a standard M3 APC on top of which has been mounted a turret with twin 20-mm anti-aircraft cannon. The turret itself was designed by Hispano-Suiza with Galileo of Italy providing the sight, Oerlikon the 20-mm cannon and Electronique Serge Dassault the radar; the last is the prime contractor for the turret before it is delivered to Panhard for installation on the chassis. The M3 VDA is known to be in service with the Ivory Coast, Niger and Abu Dhabi, and the turret can also be fitted without difficulty to other tracked and wheeled chassis such as the Renault VAB (6×6), Simbas (6×6), Panhard ERC (6×6) and Eugesa EE-11 Urutu (6×6) wheeled vehicles and on the Alvis Spartan, Steyr and, most recently, AMX-13 VCI full-tracked vehicles.

The M3 VDA has a crew of three with the commander at the front, gunner in the turret (in the centre of the hull) and the commander at the rear. The turret has full powered traverse through 360° at a speed of 60° per second, with the guns capable of elevation from −5° to +85° at a speed of 90° per second. Mounted on the turret rear is a radar scanner that rotates at a speed of 40 rpm; this carries out both surveillance and tracking functions, and can track up to four targets, information being relayed to a screen at the commander's position. The gunner has a P56T sight with magnifications of ×5 and ×12 for engaging aerial targets, a ground sight and six periscopes for all-round observation. The 20-mm cannon are mounted externally, one on each side of the turret, the gunner having the option of selecting either or both cannon. The gunner can also select single shots, bursts or full automatic fire. Two cyclic rates of fire are available, 200 or 1,000 rounds per minute. The latter is used for the anti-aircraft role. Each cannon is provided with 300 rounds of ready-use ammunition, and additional ammunition can be carried in the hull. A 7.62-mm (0.3-in) machine-gun is normally fitted for local protection, and two electrically-operated smoke dischargers are mounted on each side of the turret firing forwards. To provide a steadier firing platform, four stabilizers are lowered to the ground hydraulically before the equipment starts firing, although in an emergency the guns can be fired at the lower cyclic rate of fire without the stabilizers in position.



Above: The M3 VDA is a version of the successful Panhard M3 APC, armed with twin Oerlikon 20-mm cannon.



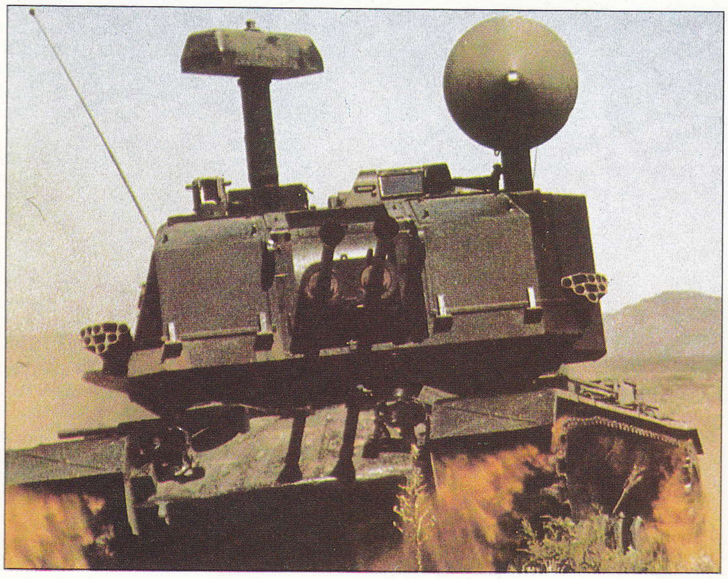
Below: Four stabilizers are lowered automatically before firing, although the guns can be fired at a low cyclic rate without them.

Specification

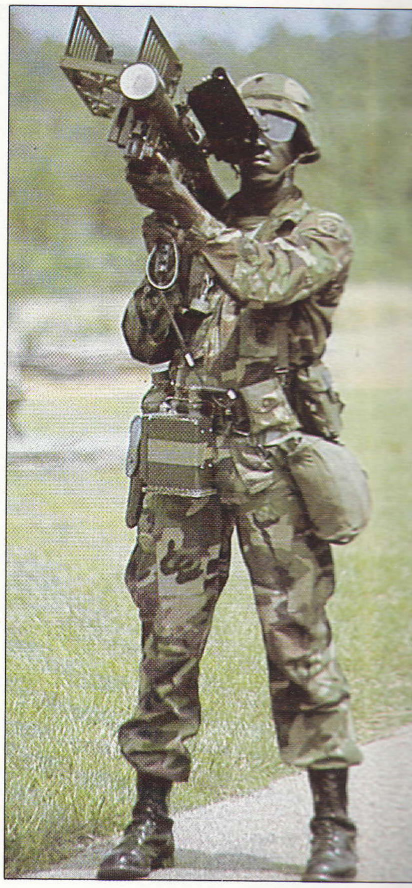
M3 VDA
Crew: 3
Weight: 7200 kg (15,873 lb)
Dimensions: length 4.45 m (17 ft 5 in); width 2.40 m (7 ft 11 in); height (excluding radar) 2.995 m (9 ft 11 in)
Powerplant: one Panhard Model 4 HD 4-cylinder air-cooled petrol engine developing 90 hp (67 kW)
Performance: maximum road speed 90 km/h (56 mph); maximum range 1000 km (621 miles); gradient 60 per cent; vertical obstacle 0.30 m (12 in); trench 0.80 m (2 ft 7 in) with one channel or 3.10 m (10 ft 2 in) with four channels

Air Defence of the American Division

Division 86 is a reorganization of the basic units of the US Army to meet the changing requirements of the modern battlefield. DIVAD (Divisional Air Defence) is undergoing a radical restructuring, with new and improved equipment being rapidly introduced.



Left: The M247 Sgt York will equip three batteries of the Divisional Air Defence Battalion, each battery comprising three platoons of four Sgt Yorks and one Stinger platoon of 15 Stinger teams. The long range and lethal ammunition of the M247 will give capability against helicopters making stand-off attacks, and some anti-missile capacity.



Right: Replacing Redeye in service, the General Dynamics Stinger has greatly-increased capability. Stinger teams are to be equipped with the AM General Hummer (HMMWV, or High-Mobility Multi-purpose Wheeled Vehicle) in place of the M151 Jeeps currently in use.

The US Army is at present in the throes of a major divisional reorganization: new equipment of improved capability is being rapidly introduced, and tactics and deployments are being revised to take account of both the new equipment and the changing threat on the battlefield of the next decade. Until fairly recently the major threat was from aircraft flying in daylight, but many of the aircraft now being introduced have a bad weather/night attack capability and can fly much lower than the aircraft they are replacing. The armed helicopter with its capability to engage tanks and other armoured vehicles at long range also present a major problem for mechanized armies. Nowhere is this more apparent than in the air defence of American divisions in Europe. The soon-to-be-introduced Patriot and the current HAWK surface-to-air missile systems will be deployed at corps level as they have such a wide arc of fire and long ranges; this is especially true of the Patriot, which will even be able to engage Soviet and other Warsaw Pact aircraft over their own territory.

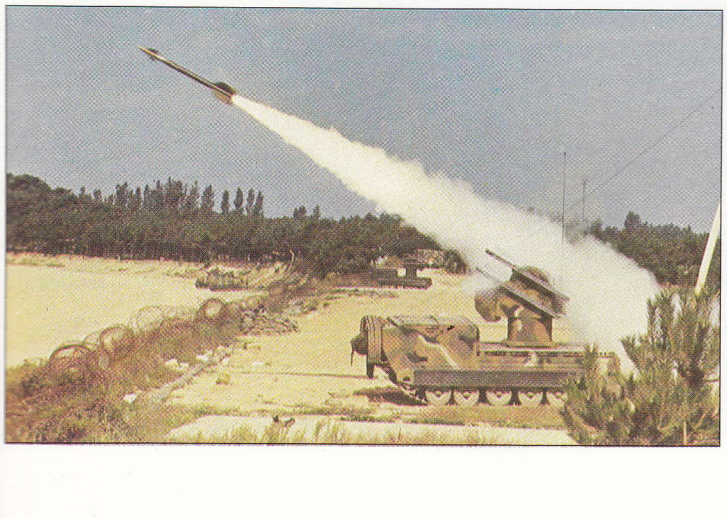
Under the new Division 86 reorganization, each Heavy Division will have one dedicated air-defence battalion. This will have a headquarters and headquarters battery, three Sgt York DIVAD (Division Air Defense)/Stinger batteries, one Improved Chaparral battery and a Stinger battery. The headquarters battery will have eight AN/MPQ-49 Forward Area Alerting Radars (FAAR) to carry out surveillance of the immediate area through 360°. These radars provide information on the air threat to the tactical operations centre at battalion HQ, which in turn passes target information to the individual weapons for subsequent engagement. In periods of low enemy activity it is probable that the surveillance radars of the DIVAD systems would be switched off, so making them more difficult to detect. Radars can themselves be neutralized by anti-radiation missiles (ARMs) launched by enemy aircraft.

The Sgt York DIVAD/Stinger battery also has a battery HQ and a total of four platoons, three each with four Sgt York equipments and the fourth platoon with 15 Stinger teams. The latter are at present carried in M151 (4×4) Jeeps, but in the mid-1980s they will be replaced by the new AM General High-Mobility Multi-purpose Wheeled Vehicle (HMMWV), which has a much greater carrying capability as well as improved cross-country performance.

The Improved Chaparral battery will have a battery HQ plus three platoons each with four systems and one platoon with six systems. The Chaparral is mounted on a full-tracked chassis that is a member of the M113 family, and has six missiles in the ready-to-launch position. The Improved Chaparral has a much improved missile and a forward-looking infra-red (FLIR) system for the engagement of targets at night and in bad weather.

The Stinger battery will have a HQ and two platoons each with 15 Stinger teams. The General Dynamics (Pomona Division) Stinger is the replacement for the old Redeye which had limited capabilities. The air-defence battalion thus has a total of 36 DIVAD, 18 Chaparral and 75 Stinger systems. In addition, individual battalions have their 12.7-mm (0.5-in) or 7.62-mm (0.3-in) machine-guns on tanks, armoured personnel carriers, self-propelled guns and even trucks for use in the anti-aircraft role.

Of all these systems it is the DIVAD that is probably the most important as it will replace the current 20-mm Vulcan system: its twin 40-mm guns have a longer range and fire more lethal ammunition, it has a fire-control system with a laser rangefinder plus tracking and surveillance radars, and it possesses the added advantage of being mounted on a M48A5 tank chassis that gives the system the ability to work with the M1 Abrams and M2 Bradley AFVs on the battlefield.



Left: Chaparral, developed from the highly successful Sidewinder AAM, has been improved considerably, and the addition of a forward-looking infra-red (FLIR) system has enhanced night and all-weather performance.

Right: Stinger will provide 75 systems for the Air Defence Battalion. The missile has an all-aspect engagement capability, is faster and longer-ranged and is more resistant to countermeasures than Redeye, the missile it is replacing. Stingers have been used operationally in limited numbers by the SAS in the Falklands.

FRANCE

AMX-13 DCA twin 30-mm self-propelled AA gun

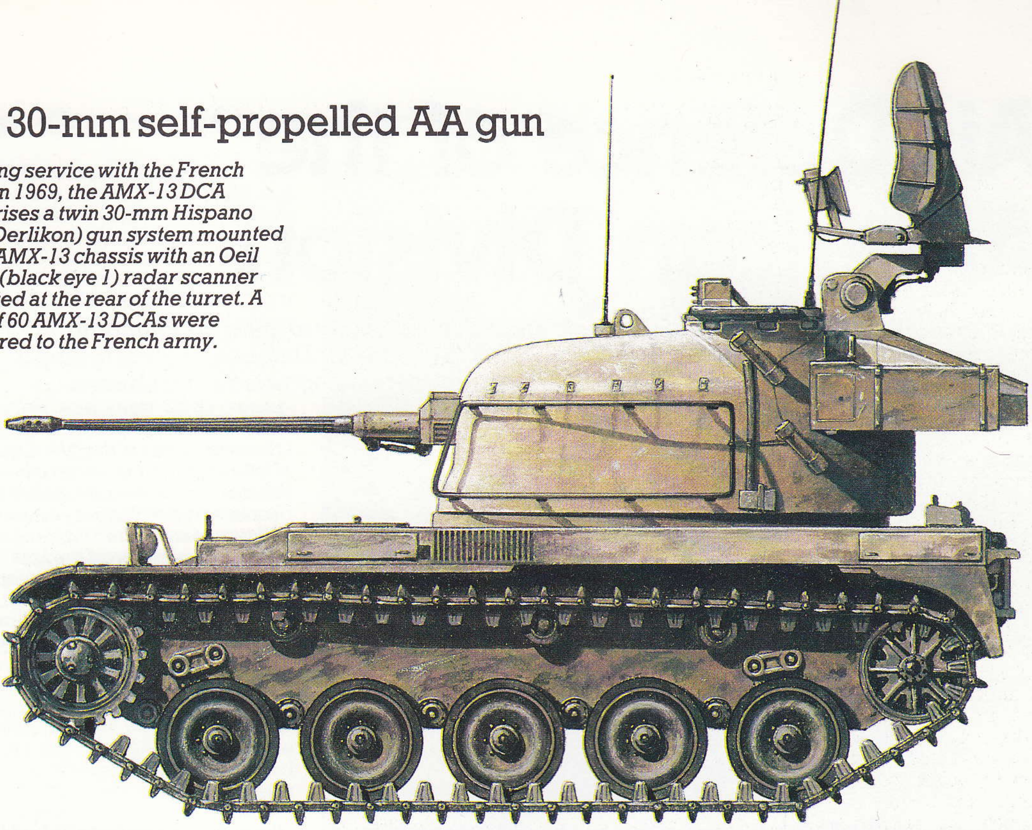
In the 1950s prototypes of a number of self-propelled anti-aircraft gun systems were designed and built to meet the requirements of the French army, but was not until the late 1960s that one of these was considered sufficiently developed to enter production. This was designated **AMX-13 DCA** (Défense Contre Avions) and was essentially an AMX-13 chassis fitted with a cast steel turret mounted on the hull at the rear. Prime contractor for the turret was SAMM, with CGT (now Thomson-CSF) responsible for the radar and its associated electronics, and with Hispano-Suiza of Switzerland (now taken over by Oerlikon-Bührle) responsible for the weapons and ammunition. Sixty AMX-13 DCA equipments were built for the French army, with final deliveries in 1969. In 1984 the AMX-13 DCA remains the only self-propelled anti-aircraft gun system in service with the French army. More recently the French army was to have received the VADAR twin 20-mm system on a VAB wheeled chassis, but this was cancelled on economy grounds several years ago.

Main armament of the AMX-13 DCA consists of twin HSS-831A 30-mm cannon with an elevation of +85° and a depression of −5° in a turret capable of traversing through 360°. Maximum rate of powered elevation is 45° per second, and of powered traverse 80° per second. Each cannon has 300 rounds of ready-use ammunition and the gunner can select single shots, 5- or 15-round bursts, or full automatic fire. The empty cartridge cases are ejected from the turret together with the links. In the anti-aircraft role the weapons have a maximum effective range of 3500 m (3828 yards), and also possess a very useful secondary capability against ground targets.

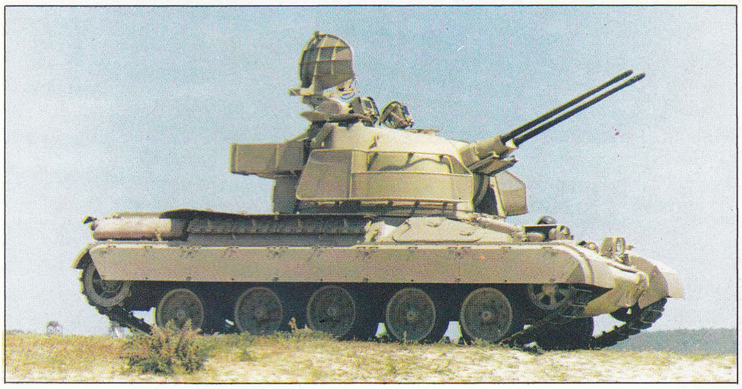
Mounted at the turret rear is the Oeil Noir 1 (black eye 1) radar scanner, which can be retracted into the turret bustle when not required. Although the cannon are normally aimed with the radar system and the anti-aircraft sights, sights are also provided for the engagement of ground targets. Mounted on each side of the turret is a bank of three electrically-operated smoke dischargers.

In the 1960s this DCA turret was also fitted to the chassis of the AMX-30 MBT, but the combination was not adopted by the French army as it was already ordering the Roland SAM system on the AMX-30 chassis. To provide close-in defence to its Thomson-CSF/MATRA Shahine mobile surface-to-air missile systems, Saudi Arabia ordered 53 examples of a more up-to-date version of this turret on the AMX-30 chassis, and by 1984 all of these equipments had been delivered. This is called the **AMX-30 SA**, and its turret is fitted with the more powerful Thomson-CSF Oeil Vert (green eye) radar as well as improved electronics. Thomson-CSF has also developed with SAMM the SABRE turret, which has for trials purposes already been installed on a number of other chassis such as the Chieftain MBT, Marder MICV and Steyr-Daimler-Puch APC. This also has twin 30-mm cannon but a different fire-control system.

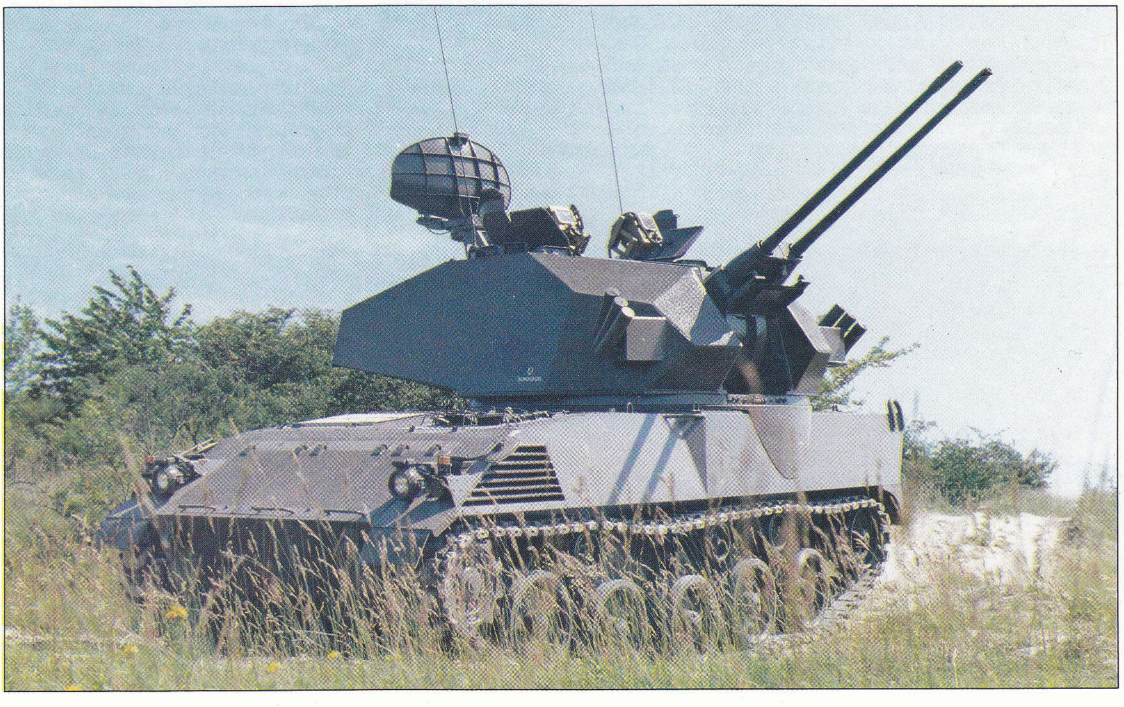
Specification
AMX-13 DCA
Crew: 3
Weight: 17200 kg (37,919 lb)
Dimensions: length 5.40 m (17 ft 11 in); width 2.50 m (8 ft 2 in); height (radar up) 3.80 m (12 ft 6 in); height (radar down) 3.00 m (9 ft 10 in)
Powerplant: one SOFAM Model 8Gxb 8-cylinder water-cooled petrol engine developing 250 hp (186 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range 300 km (186 miles); gradient 60 per cent; vertical obstacle 0.65 m (2 ft 2 in); trench 1.70 m (5 ft 7 in)



Entering service with the French army in 1969, the AMX-13 DCA comprises a twin 30-mm Hispano (now Oerlikon) gun system mounted on an AMX-13 chassis with an Oeil Noir 1 (black eye 1) radar scanner mounted at the rear of the turret. A total of 60 AMX-13 DCAs were delivered to the French army.



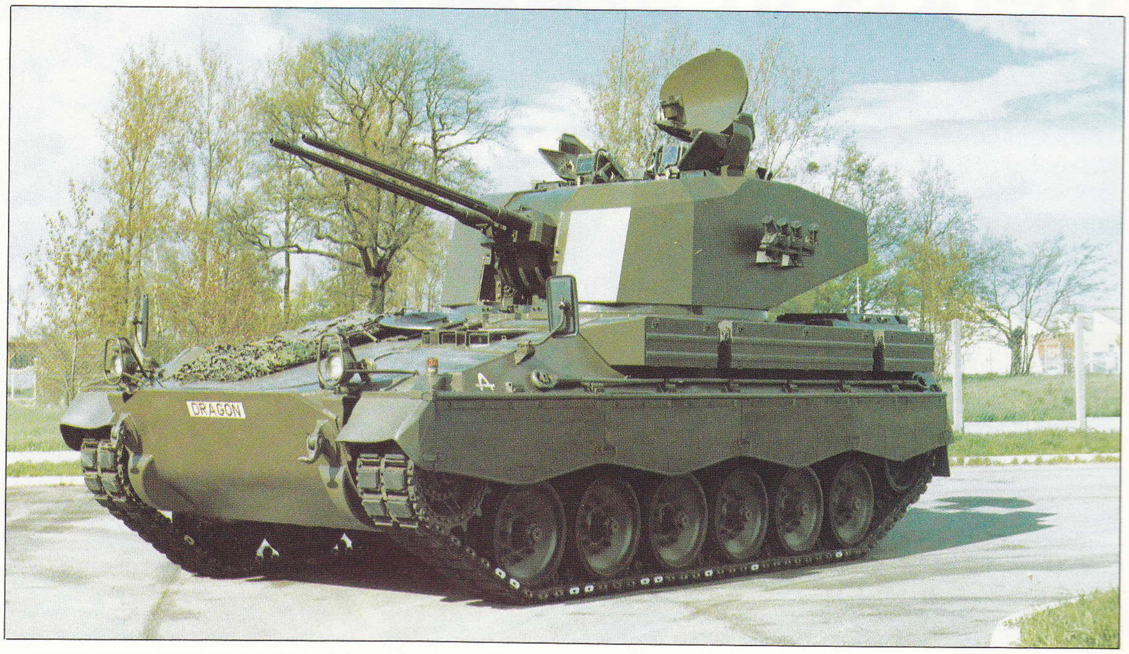
Above: As a private venture, the DCA turret was mounted onto an AMX-30 MBT chassis, but found no buyers. A version with an improved turret was sold to Saudi Arabia, and by 1984 the last of 53 examples ordered had been delivered.



Below: Pursuing a line of development from the original DCA turret through the Saudi AMX-30 SA and the Dragon, Thomson-CSF have developed the Sabre. The twin 30-mm system has been mounted for trials purposes onto a Steyr APC, but has also been tested on the Chieftain MBT and the Marder.

WEST GERMANY/FRANCE

Dragon twin 30-mm self-propelled AA gun



Mounted on a Marder-type chassis, the new Dragon system is equipped with the Oeil Vert (green eye) radar used on the Saudi AMX-30.

Given the ever increasing cost of defence equipment, there has been an increasing trend since the 1960s, especially in Europe, for the co-operative development of weapon systems. For example, the 155-mm (6.1-in) FH-70 howitzer has been developed by West Germany, Italy and the United Kingdom, with production undertaken in all three countries. Private-venture development has also taken place along similar lines as in the case of the **Dragon** twin 30-mm SPAAG. The chassis has been developed by Thyssen-Henschel while the turret and its associated fire-control system have been developed by the Electronics Systems Division of Thomson-CSF. The chassis is similar to that of the Marder MICV and TAM medium tank, and is of all-welded steel construction which provides the crew with protection from small arms fire and shell splinters. The driver is seated at the front left with the engine to his right, the turret is in the centre and the reserve ammunition supply is at the rear of the hull. The Dragon retains the power-operated ramp in the hull rear allowing quick access to the reserve ammunition supply. The torsion-bar suspension consists of six dual rubber-tyred road wheels, with the drive sprocket at the front, and the idler at the rear; there are three track-return rollers. The upper part of the track is covered by a rubber skirt that helps to keep the dust down. Like the TAM tank, the Dragon can be fitted with additional fuel tanks at the rear of the hull to increase operating range from 600 km (373 miles) to 1000 km (621 miles).

The all-welded steel turret is in the centre of the hull, with the commander seated on the left and the gunner on the right. Mounted at the rear of the turret is the Oeil Vert (green eye) radar that carries out both tracking and surveillance functions; when not required the radar can be retracted into the turret bustle. Both the commander and gunner are provided with a sight for engaging ground targets, as well as periscopes for observation purposes.

The turret has full powered traverse through 360° at a speed of 35° per second, and the twin 30-mm cannon can be elevated from −8° to +85° at a speed of 30° per second. Turret traverse and weapon elevation are hydraulic, with manual controls for emergency use. The gunner can select bursts of one to five rounds, or a burst of 15 rounds. The weapons have a maximum effective range of 3000 m (3,280 yards), and can also be used against ground targets. In the latter role SAPHEI (semi-armour-piercing high explosive incendiary) ammunition would be used to penetrate the thin armour of APCs before exploding inside the vehicle.

The Dragon SPAAG has yet to enter production and has been developed specifically for the export market. Further development of the turret by Thomson-CSF has resulted in the SABRE turret which has already been fitted for trials purposes onto the British Chieftain MBT and Austrian Steyr APC chassis; it is also being proposed for the French AMX-10RC (6×6) armoured car.

Specification

Dragon

Crew: 3

Weight: 31000 kg (68,342 lb)

Dimensions: length 6.775 m (22 ft 3 in); width 3.12 m (10 ft 3 in); height (radar up) 4.195 m (13 ft 11 in)

Powerplant: one MTU 6-cylinder supercharged diesel developing 720 hp (536 kW)

Performance: maximum road speed 72 km/h (45 km/h); maximum range 600 km (373 miles); gradient 65 per cent; vertical obstacle 1.00 m (3 ft 3 in); trench 2.50 m (8 ft 2 in)

WEST GERMANY/SWITZERLAND

Gepard twin 35-mm self-propelled AA gun

When the West German army was formed in the 1950s it was supplied with some 500 M42 twin 40-mm self-propelled anti-aircraft gun systems by the United States. The M42 had quite a good range but lacked any kind of onboard fire-control system. From the late 1960s various projects were initiated for the development of a new SPAAG, but these all came to nothing. In 1966 contracts were issued for the development on a SPAAG based on the chassis of the Leopard 1 MBT which had recently entered production for the West Germany army, and after the completion of systems with twin 30-mm and twin 35-mm cannon the latter was selected for full-scale development. The prime contractor for the twin 35-mm system was Contraves of Switzerland and after the construction of additional prototypes this system was selected for service with the West German army as the **Flakpanzer Gepard**. The first production vehicle was completed in 1976 and

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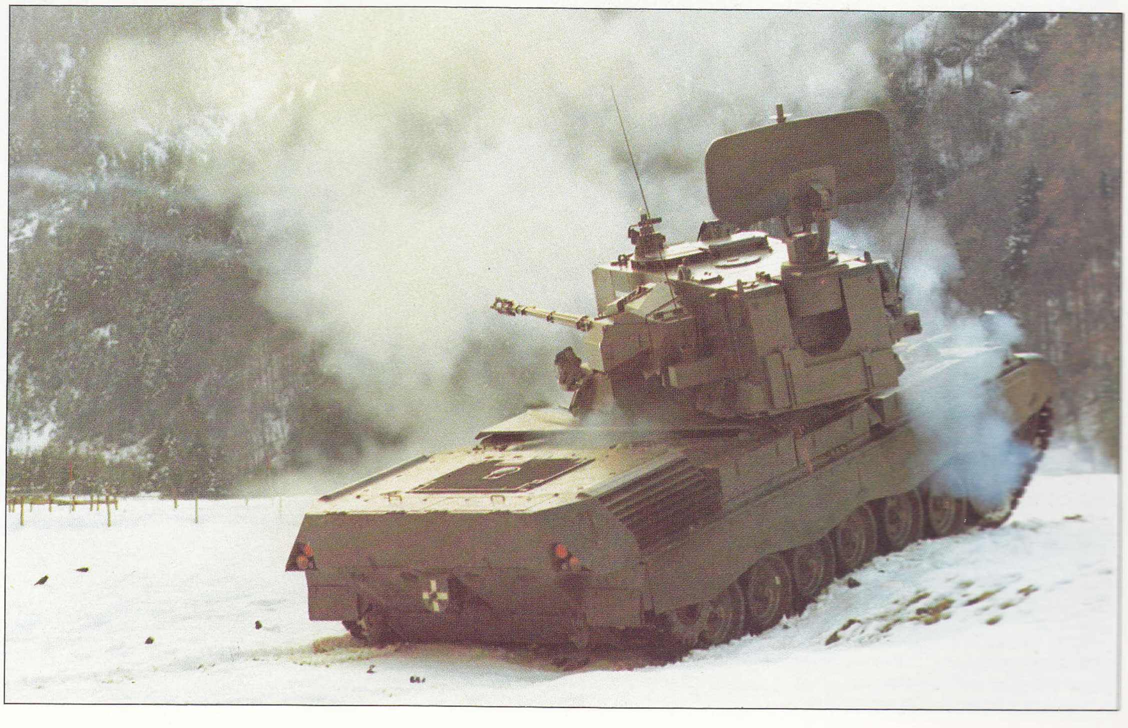


The Flakpanzer Gepard consists of a twin 35-mm Contraves turret mounted on a modified West German Leopard I MBT chassis.

Trends in SPAAG systems

Tied as it is to the evolution of combat aircraft capability, air defence has had to develop the capacity to combat all-weather and night attacks, greater target speeds and stand-off weaponry. This has led to a requirement for gun systems with longer range, increased accuracy and assured lethality.

Self-propelled anti-aircraft (SPAAG) gun systems are by no means a new invention, armoured trucks fitted with guns having been developed before World War I to engage the balloons used for artillery spotting. One of the first such systems was the German Panzerkraftwagen Ehrhardt fitted with a turret-mounted 5-cm gun, which appeared in 1906. Although serious development of SPAAGs started in the 1920s, it was not until World War II that they appeared in large numbers. During this conflict large numbers were built on wheeled, half-track and full-tracked chassis by the major powers, with Germany making the greatest effort as it rapidly lost air superiority over Europe. In 1984, well over 40 years after the type was first used, several countries still use versions of the American half-track with four 12.7-mm (0.5-in) machine-guns or two 20-mm cannon. The Israeli army has a half-track version of the TCM-20 twin 20-mm system, and this is credited with shooting down no less than 60 per cent of the aircraft downed by ground-based systems (guns and missiles) during the 1973 Middle East War. The systems developed during World War II were in a variety of calibres ranging from 7.62-mm (0.3-in) up to 88-mm (3.46-in) calibre, but were all essentially clear-weather systems aimed by optical sights. Most had manual controls for turret/gun traverse and weapon elevation even though these were often tiring for the crew and made the engagement of fast and low-flying aircraft very difficult.

In the post-war period the Americans fielded the M42 twin 40-mm SPAAG, but this was only a new chassis with the turret of the older M19. More sophisticated fire controls were designed for the M42 but none of these entered production as they were complicated, expensive and unreliable. By the 1960s it was obvious that the M42 could not cope with the new generation of jet aircraft so the 20-mm General Electric Vulcan cannon, as installed in American fighters at the time (and still being installed in modern aircraft), was mounted in a turret on a modified M113 APC chassis and fitted with a naval gunsight and range-only radar. This was fielded as the M163 Vulcan SPAAG, its towed version for non-armoured and mechanized divisions being designated M167.

In 1970 the US Army carried out the Gun Defense Effectiveness Study (GADES) and came to the conclusion that the Vulcan system was limited in range, accuracy and lethality. In fact its range and lethality are probably both a good deal less than those of the M42 that it replaced. In 1973 a twin 25-mm Gun Low-Altitude Air Defense System (GLAADS) was built to the prototype stage, but this was essentially a test-bed for contemporary advances in technology, especially in the areas of fire control. In 1978 General Dynamics Pomona Division and Ford Aerospace and Communications were each awarded a contract for the design, development and construction of two prototypes each of the Division Air Defense (DIVAD) gun system. Following trials with the twin 35-mm General Dynamics and twin 40-mm Ford systems the latter was selected for production, first deliveries being made late in 1983. The National Guard still uses the older M42 SPAAG, but it is expected that as DIVADs are introduced into the Regular Army the M163 Vulcans will be modernized in the area of fire control and passed on to the National Guard, so allowing the M42s to be phased out of service. In time of war the National Guard would deploy to Europe, so ammunition supply could be a problem with the Regular Army having the 40-mm DIVAD and the National Guard the 20-mm Vulcan. The M42 could be modernized, however, and one already has been updated for trials purposes. In both Vietnam and Korea, American SPAAGs were used mainly in the ground-support role rather than in their originally designed anti-aircraft role.

Following its experience during World War II the re-formed West German army took delivery of some 500 M42 SPAAGs from the United States. It realized that a new and more effective system was needed, and after many false starts built prototypes of twin 30-mm and twin 35-mm systems on a modified Leopard 1 MBT chassis. The latter was selected for production and by 1980 a total of 420 Gepards had been delivered to the West German army, 55 to Belgium and 95 to The Netherlands.

The Soviet Union followed a similar route, first fielding a clear-weather system (the twin 57-mm ZSU-57-2) and then an all-weather system (the ZSU-23-4). The latter has been widely deployed, and has proved to be one of the most effective systems of the 1973 Middle East War when used in conjunction with SAMs. The Soviets are expected to field a new SPAAG in the near future; this could be a 30-mm weapon, perhaps developed from a naval weapon of the same calibre.

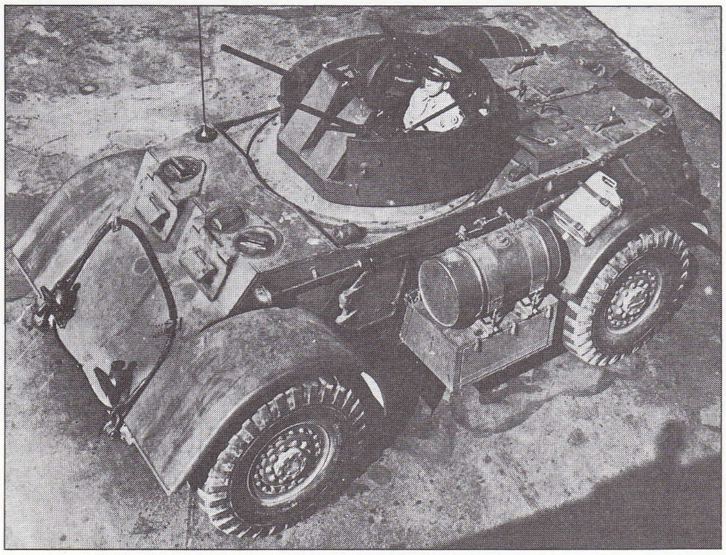
The United Kingdom has shown little recent interest in SPAAGs, relying instead on SAMs for the air defence of its army. France has just 60 SPAAGs, while Italy has none at all, although a quadruple 25-mm system is being developed.

While such systems as the Gepard and DIVAD are highly effective weapons, they are expensive to procure, and then cost much to maintain and operate. For this reason in recent years there have been several SPAAGs developed in Europe specifically for the export market. These range from complete systems such as the Swiss private-venture Oerlikon-Bührle twin 35-mm GDF series to turrets such as the Hispano-Suiza CNMP H 20 R/H 20 S twin 20-mm turret that can be fitted on a variety of tracked or wheeled chassis and provided with a surveillance radar if required. Another recent idea is the development of a modular system with options ranging from a simple clear-weather system right up to an all-weather system. Such a system is the West German private-venture Wildcat, which in early 1984 was being evaluated by the Canadian Armed Forces. All-weather SPAAGs normally have surveillance and tracking radar, computers and a laser rangefinder.

It is only in the last 10 years that effective all-weather SPAAGs have been developed, mainly as a result of rapid advances in electronics. In the 1950s electronics tended to be not only expensive, but also bulky and unreliable, especially in tracked and wheeled vehicles that are subjected to violent cross-country movement.

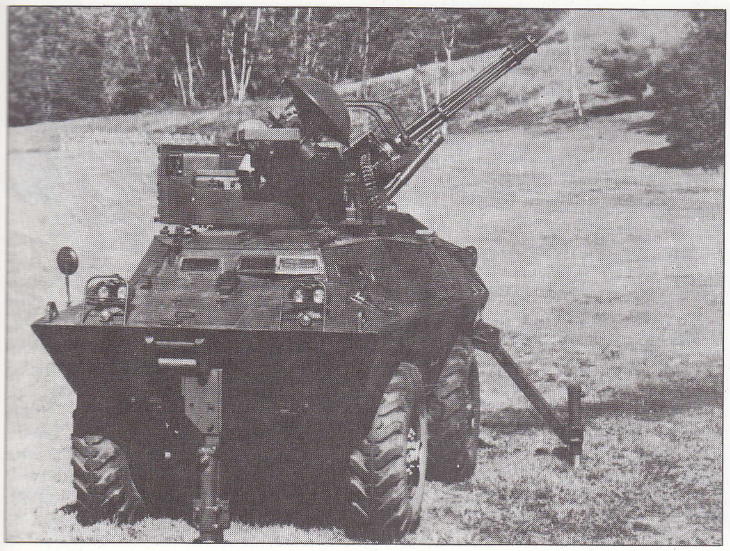
In addition to SPAAGs, many self-propelled SAMs have been developed in the last 25 years, but most of these are so expensive that they can only be developed under government contract, a recent exception to this being the Swiss Oerlikon-Bührle ADATS. Another recent idea, not yet adopted by any army, is to add two short-range missiles to a SPAAG. For example, a Gepard could have two Stinger SAMs fitted for use while the system was being reloaded with ammunition, which is for many SPAAGs a time-consuming task that also leaves the vehicle completely vulnerable.

One of the major problems with SPAAGs and SAMs is the integration of all these components into an effective air-defence system through which enemy aircraft cannot penetrate, but in which friendly aircraft can fly without danger of being engaged and shot down by their own side. Much work has to be done in NATO before this can be accomplished successfully.



During World War II, anti-aircraft weapons had to cope with attackers which operated in reasonably clear air; optical sighting and manual control allied to machine-gun calibre weapons were therefore often sufficient to provide adequate protection against attack.

By the 1960s it was obvious that, given the increased abilities of tactical aircraft, some kind of blind firing system allied to larger calibre weapons was necessary. The Soviet ZSU-23-4 has been one of the most successful of the new generation of equipment.



Above: The United States adapted an aircraft weapon, developed in the 1950s for the supersonic Lockheed F-104 Starfighter, for its anti-aircraft needs. Of 20-mm calibre, the phenomenal rate of fire of the Vulcan was its main advantage, but it was handicapped by a relatively short range.

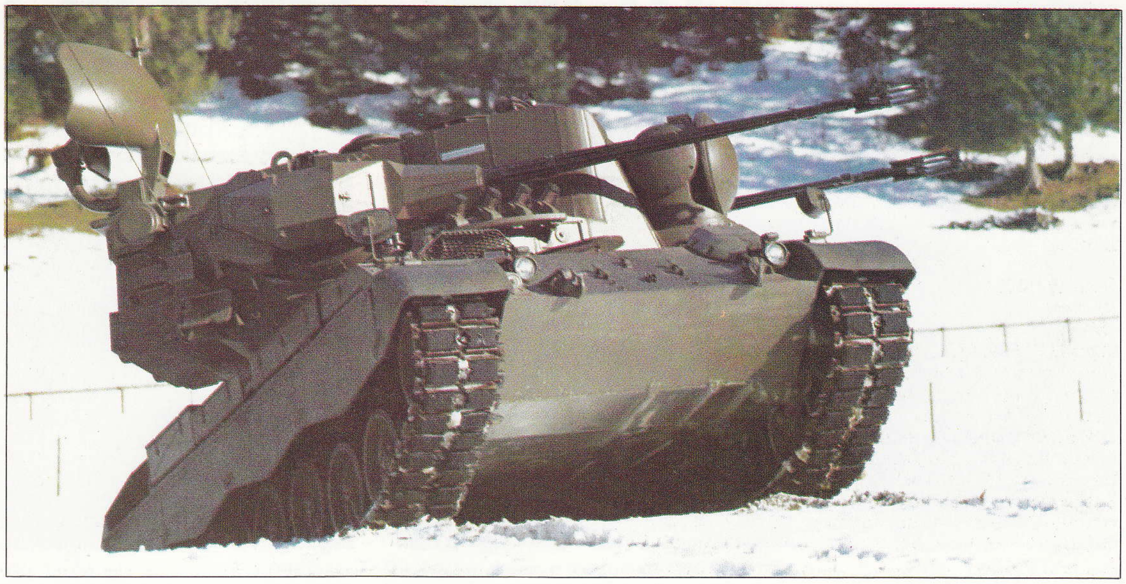
Above right: The impact of the armed helicopter on the battlefield, with its capacity to make stand-off attacks from low level at a distance, has meant that guns must be able to detect and engage such targets at long ranges. The twin 35-mm guns and comprehensive electronic and detection equipment of the Gepard is a typical (if expensive) solution.

Below: The M247 Sgt York, with its twin 40-mm cannon and state-of-the-art electronics, is being introduced to significantly enhance the US Army's air defence capability, designed to counter long-range helicopter attacks and the new generation of armoured attack aircraft.

Right: The expense involved in acquiring a capable modern system is often beyond the means of smaller nations, and manufacturers have made efforts to cater for their needs by introducing simpler systems of modular construction, such as the private-venture Wildcat from West Germany.

final deliveries were made in 1970. Some 420 Gepards were built for the West German army, 55 for the Belgian army and 95 for the Dutch army. The last differed from the Belgian and West German vehicles in that the turret was fitted with a Dutch Hollandse Signaalapparaten surveillance and tracking radar with moving-target indication and other minor differences. The turret can also be installed on other chassis such as the Swiss Pz 68 MBT and Italian OTO Melara OF-40, and more recently Saudi Arabia has expressed an interest in acquiring up to 100 of a modernized version of this turret fitted to the chassis of the Leopard 2 MBT.

The chassis of the Gepard is similar to that of the Leopard 1 but with thinner armour protection for the hull. The driver is at the front of the hull on the right, with the auxiliary power unit to his left; the turret is in the centre; and the engine and transmission are at the rear. Suspension is of the torsion-bar type, and consists of seven dual rubber-tyred road wheels, with the idler at front and the drive sprocket at the rear; there are two track-return rollers. The search radar is mounted at the turret rear and can be folded down if required, while the tracking radar is on the front of the turret. Mounted externally on each side of the turret is a 35-mm Oerlikon KDA cannon with a cyclic rate of fire of 550 rounds per minute. This weapon is provided with 310 rounds of ready-use anti-aircraft ammunition and 20 rounds of APDS-T (armour piercing discarding sabot-tracer) for the engagement of ground targets. In addition to the APDS-T ammunition, HEI (high explosive incendiary), HEI-T (high explosive incendiary-tracer), practice and SAPHEI-T (semi-armour-piercing high explosive incendiary tracer) ammunition is available. In addition to the tracking and surveillance radars the Gepard has a comprehensive fire-control system, onboard land navigation system, sights for engaging both aerial and ground targets, and an NBC system. Some of the West German Gepards have been fitted with a Siemens laser rangefinder.



Gepard is equipped with both tracking and surveillance radars, and onboard equipment includes computerized fire control and navigation equipment and an NBC system.

Specification

Gepard
Crew: 3
Weight: 47300 kg (104,278 lb)
Dimensions: length (guns forward) 7.73 m (25 ft 4 in); length (hull) 6.85 m (22 ft 6 in); width 3.37 m (11 ft 1 in); height (radar elevated) 4.03 m (13 ft 3 in); height (periscopes) 3.01 m (9 ft 11 in)
Powerplant: one MTU MB 838 Ca M500 V-10 diesel developing 830 hp (619 kW)
Performance: maximum road speed 65 km/h (40 mph); maximum road range 550 km (342 miles); gradient 60 per cent; vertical obstacle 1.15 m (3 ft 9 in); trench 3.00 m (9 ft 10 in)

WEST GERMANY

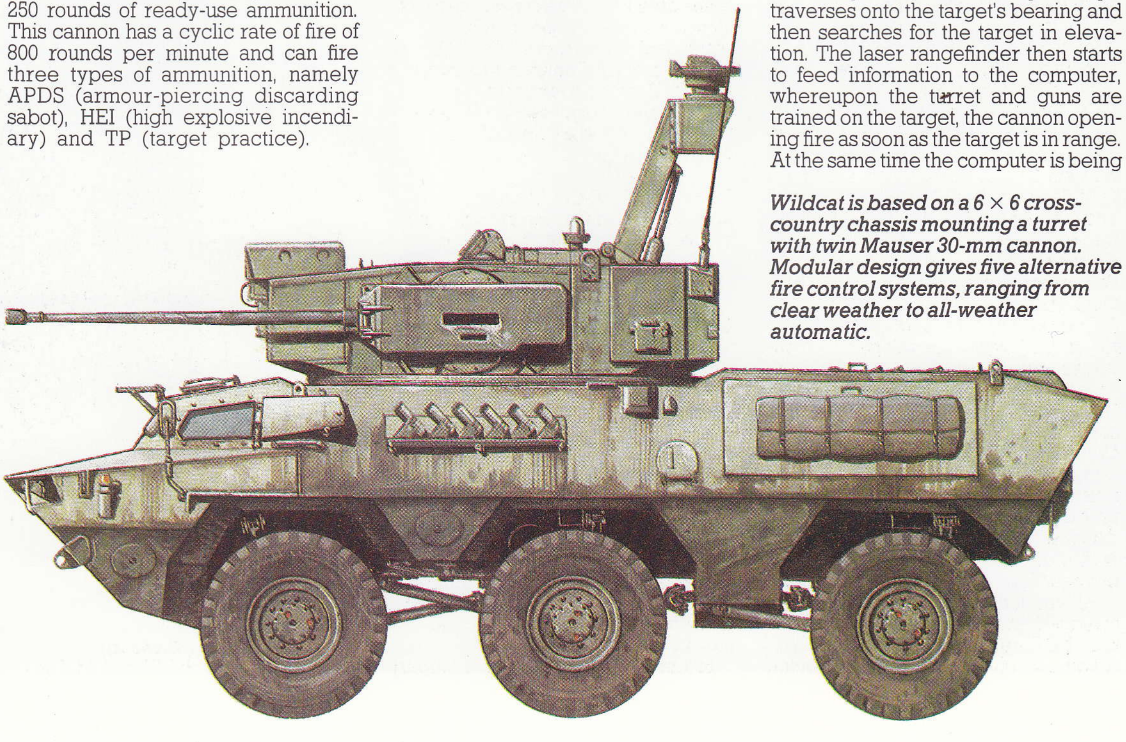
Wildcat twin 35-mm self-propelled AA gun

Krauss-Maffei of Munich built all of the Gepard twin 35-mm self-propelled anti-aircraft guns on a modified Leopard 1 chassis delivered to the Belgian, West German and Dutch armies. The company realized, however, that although this was a highly effective system for European armies it was too heavy, complicated and expensive for many countries overseas. With this in mind a decision was made to develop a complete family of self-propelled anti-aircraft gun systems that would be able to meet the requirements of almost every customer. Given Krauss-Maffei's experience with the Transportpanzer 1 (6×6) cross-country vehicle, already in production for the West German army, a decision was taken to use automotive components of this vehicle in a new hull which could be fitted with a turret armed with twin 30-mm cannon. Five different fire-control options are available, these ranging from the **V1** clear-weather system with optical tracking to the **V3** with radar target-detection and automatic target-tracking, up to the **V5** with an all-weather fire-control system and automatic target-tracking. As of early 1984 only one prototype had been built (to the V3 configuration), although a decision had been taken to build another prototype to the **V4** configuration, and this is expected to be ready for trials in 1985.

The basic layout of the **Wildcat**, as the system is designated, is the same in all versions, with the driver and radio operator/gunner in the front, turret in the centre, and engine and transmission at the rear. The suspension consists of axles with coil springs and hydraulic shock absorbers to provide good cross-country ride. Steering is power-assisted on the front four wheels, and run-flat tyres can be fitted.

The turret is fitted with two externally-mounted 30-mm Mauser Mk 30-F cannon (one on each side), each with 250 rounds of ready-use ammunition. This cannon has a cyclic rate of fire of 800 rounds per minute and can fire three types of ammunition, namely APDS (armour-piercing discarding sabot), HEI (high explosive incendiary) and TP (target practice).

A typical target engagement could take place as follows. The radar operator/gunner monitors his radar scope on a constant basis, and once an aircraft has been spotted by the radar and appeared on his scope, the operator must then determine whether or not it is hostile. If the target is confirmed by IFF as hostile the periscope traverses onto the target's bearing and then searches for the target in elevation. The laser rangefinder then starts to feed information to the computer, whereupon the turret and guns are trained on the target, the cannon opening fire as soon as the target is in range. At the same time the computer is being

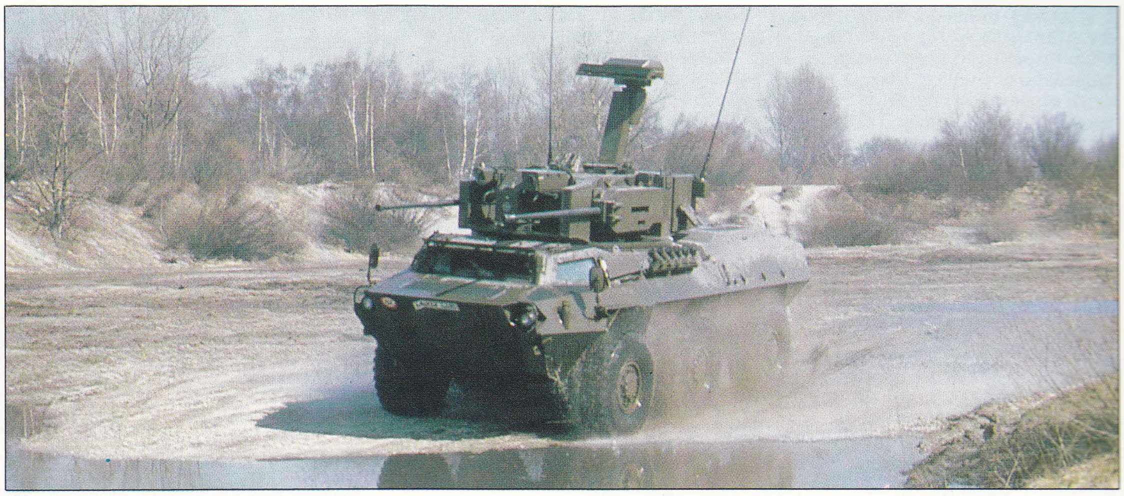


Wildcat is based on a 6 × 6 cross-country chassis mounting a turret with twin Mauser 30-mm cannon. Modular design gives five alternative fire control systems, ranging from clear weather to all-weather automatic.

updated with new information should a second burst be required to destroy the target. In addition to use in the anti-aircraft/anti-helicopter role with a range of about 3000 m (3,280 yards), the weapons can also be used to engage ground targets. A more recent concept, called the **V6**, is to replace the twin 30-mm cannon by short-range missiles such as the American General Dynamics Stinger or British Shorts Blowpipe/Javelin.

Specification

Wildcat
Crew: 3
Weight: 18500 kg (40,785 lb)
Dimensions: length 6.88 m (22 ft 7 in); width 2.98 m (9 ft 9 in); height (radar down) 2.74 m (9 ft 0 in)
Powerplant: one Mercedes-Benz turbocharged 8-cylinder diesel developing 320 hp (239 kW)
Performance: maximum road speed 80 km/h (50 mph); maximum range 600 km (373 km); gradient 60 per cent



Wildcat is designed as an alternative to the capable but extremely costly systems such as Gepard and Sgt York, and is available with a range of capabilities. The automotive components are derived from the Transportpanzer.

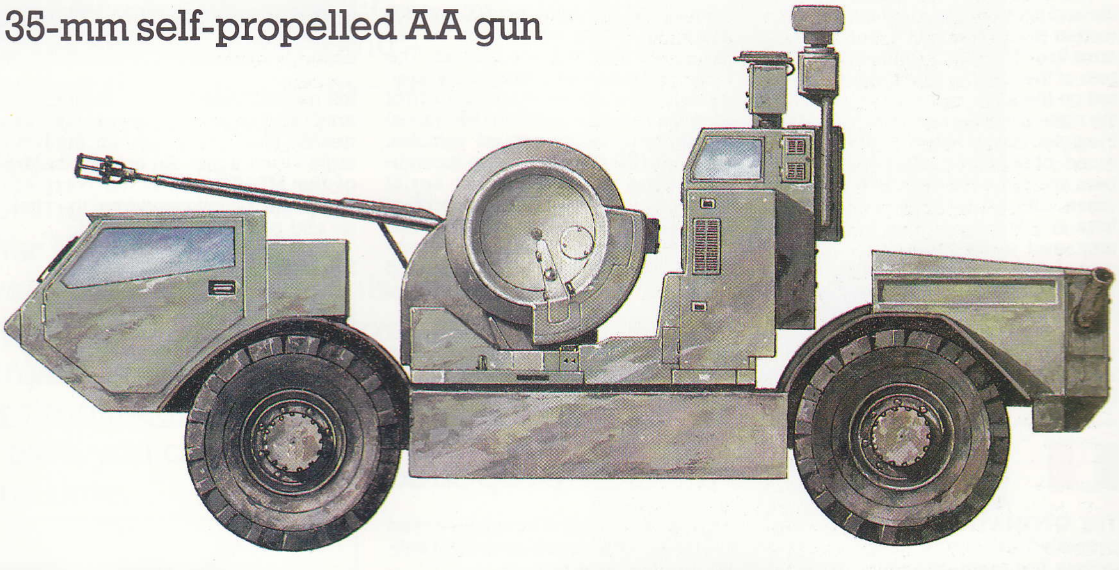
SWITZERLAND

GDF-CO3 twin 35-mm self-propelled AA gun

For many years the Swiss-based company Oerlikon-Bührle, with subsidiaries in Italy and the United Kingdom, has produced the world's largest range of towed anti-aircraft guns including the highly successful GDF series of 35-mm weapons, of which more than 1,500 have been manufactured. It also designed the armament and weapons used in the West German Gepard twin 35-mm anti-aircraft gun system. The company also realized that there was a requirement for a highly mobile twin 35-mm system to defend rear-area targets such as airports, command centres and factories, and that such a system would not need to be based on a MBT chassis as was the Gepard. The result has been the GDF series of twin 35-mm anti-aircraft gun systems, which was announced several years ago. Two chassis are offered, one tracked and the other wheeled. The tracked chassis is a longer (by an additional road wheel on each side) version for the well known M548 tracked cargo carrier, itself a member of the M113 series of tracked armoured vehicle of which over 70,000 have been produced to date by the FMC Corporation of San Jose, California, for the home and export markets. The wheeled system is based on the chassis of the HYKA cross-country vehicle and offers a higher road speed and greater operational range than the tracked version, although it is some 3.5 tonnes heavier. In both cases two fire-control systems are offered, the **GDF-CO2** (tracked) and the **GDF-DO2** (wheeled) systems having a day/night fire-control system developed by Contraves and including a laser rangefinder; and the **GDF-CO3** (tracked) and **GDF-DO3** (wheeled) systems being similar apart from the addition of a Contraves (Italy) search radar that has a maximum range of some 23 km (14 miles). For most applications a customer would probably order one vehicle fitted with the radar to every three without the radar, the former then supplying target information to the others.

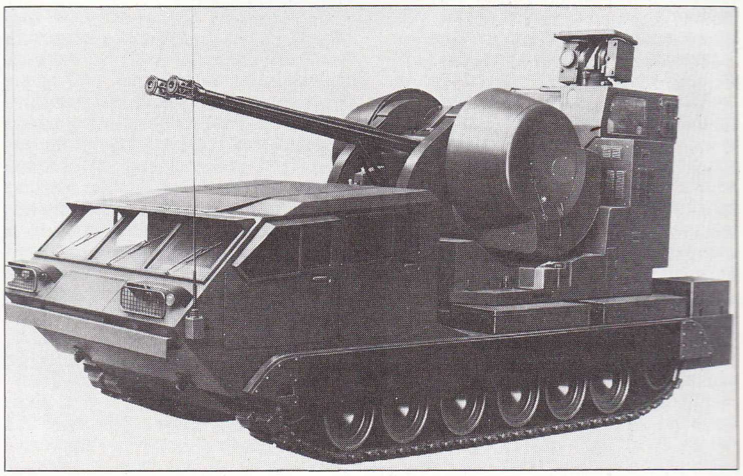
All versions are fitted with a power-operated turret armed with twin 35-mm KDF cannon and 430 rounds of ready-use ammunition. Each cannon has a cyclic rate of fire of 600 rounds per minute. Effective range of the 35-mm cannon is about 3500 m (3,830 yards), and type of ammunition that can be fired include HEI (high explosive incendiary), HEI-T (high explosive incendiary-tracer), SAPHEI-T (semi-armour-piercing high explosive incendiary-tracer), APDS-T (armour-piercing discarding sabot-tracer) and practice. The APDS-T round is used against ground targets such as light tanks and armoured personnel carriers, and will penetrate 40 mm (1.6 in) of armour at an angle of 60° at a range of 1000 m (1,094 yards).

In both systems the crew compartment is at the front of the vehicle with the turret at the rear, and has a three-man crew consisting of vehicle commander, gunner and driver.



Above: Developed for the task of defending rear area targets such as airports, factories, ports and command centres, the GDF-DO3 has twin 35-mm KDF cannon mounted on the HYKA cross-country truck chassis, and is equipped with laser rangefinder and a Contraves (Italy) search radar.

Right: The GDF-CO2 has the same armament and fire control system as the wheeled version, but has no search radar. The vehicle is based on a derivative of the American M113.

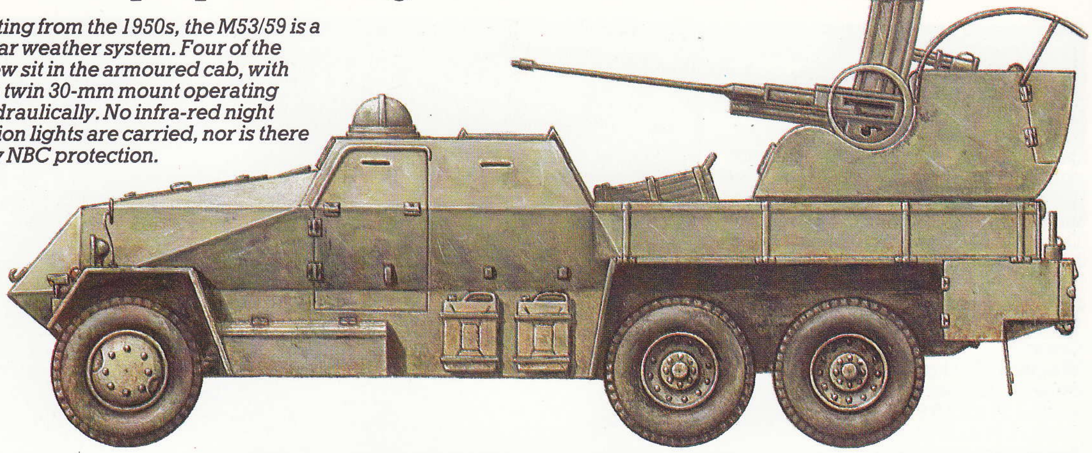


Specification

GDF-CO3
Crew: 3
Weight: 18000 kg (39,683 lb)
Dimensions: length 6.70 m (22 ft 0 in); width 2.813 m (9 ft 3 in); height 4.00 m (13 ft 2 in)
Powerplant: one GMC 6V-53T 6-cylinder diesel developing 215 hp (160 kW)
Performance: maximum road speed 45 km/h (28 mph); maximum road range 480 km (297 miles); gradient 60 per cent; vertical obstacle 0.609 m (2 ft 0 in); trench 1.80 m (5 ft 11 in)

CZECHOSLOVAKIA

M53/59 twin 30-mm self-propelled AA gun



Dating from the 1950s, the M53/59 is a clear weather system. Four of the crew sit in the armoured cab, with the twin 30-mm mount operating hydraulically. No infra-red night vision lights are carried, nor is there any NBC protection.

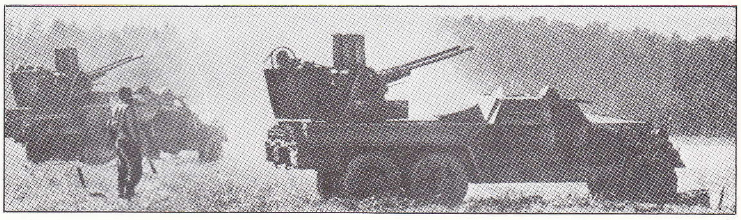
It is widely believed that the Soviet Union forces its Warsaw Pact countries either to purchase Soviet equipment or manufacture it under licence. In fact some of the Warsaw Pact countries have their own flourishing defence industries, one such being Czechoslovakia, which has recently developed a 152-mm (6-in) self-propelled gun on an 8×8 Tatra truck chassis. In the 1950s Czechoslovakia developed and placed in production the **M53/59** twin 30-mm self-propelled anti-aircraft gun system, and this is known to be in service with Libya and Yugoslavia in addition to the Czech army itself. In some Czech units, however, the M53/59 has already been replaced by the ZSU-23-4 SPAAG which is a much more effective system.

The M53/59 was used by the Czech army in place of the Soviet ZSU-57-2 SPAAG, and consists essentially of the Praga V3S (6×6) 3-tonne truck chassis fitted with an armoured cab and a twin M53 30-mm anti-aircraft gun system at the rear.

The engine is at the front of the vehicle and provided with full armour protection from shell splinters and small arms fire. The cab is to the immediate rear of the engine, with the driver seated on the left and the commander on the right; the latter has a hemispherical Plexiglas cupola in the cab roof for all-round observation. Both crew members are provided with side door and vision slits while to their immediate front is a windscreen covered by an armoured shutter in combat. To the rear of the commander and driver are the two ammunition members, who sit facing the rear.

The twin 30-mm mount has hydraulic power traverse through 360°; the weapons elevate from −10° to +85°. Cyclic rate of fire is 450 to 500 rounds per gun per minute, while the practical rate of fire (conditioned by ammunition resupply) is 150 rounds per minute per gun. The basic towed 30-mm M53 is fed with clips of 10 rounds whereas the M53/59 has a 50-round vertical magazine for each gas-operated cannon. It is estimated that between 600 and 800 rounds of 30-mm ammunition of two types (API and HEI) are carried. The API (armour-piercing incendiary) projectile will penetrate 55 mm (2.16 in) of armour at a range of 500 m (546 yards) and is used mainly against vehicles, while the HEI (high explosive incendiary) round is used against aerial targets. Both have a muzzle velocity of 1000 m (3,280 ft) per second. Effective anti-aircraft range of the system is estimated to be 3000 m (3,280 yards) and maximum vertical range is 6300 m (20,670 ft).

Apart from its obvious drawback of being a clear-weather anti-aircraft system, the M53/59 also lacks cross-country mobility when operating with full-tracked vehicles such as tanks and armoured personnel carriers, and has neither NBC protection nor infra-red night-vision lights. An unusual feature of the M53/59 is that the complete mount can be removed from the chassis and placed on the ground.



The age of the M53/59 is displayed by the lack of protection for the gunners, and its lack of cross-country mobility would hamper operations with tracked vehicles.

Specification

M53/59
Crew: 6
Weight: 10300 kg (22,707 lb)
Dimensions: length 6.92 m (22 ft 8 in); width 2.35 m (7 ft 9 in); height (without magazines) 2.585 m (8 ft 6 in)

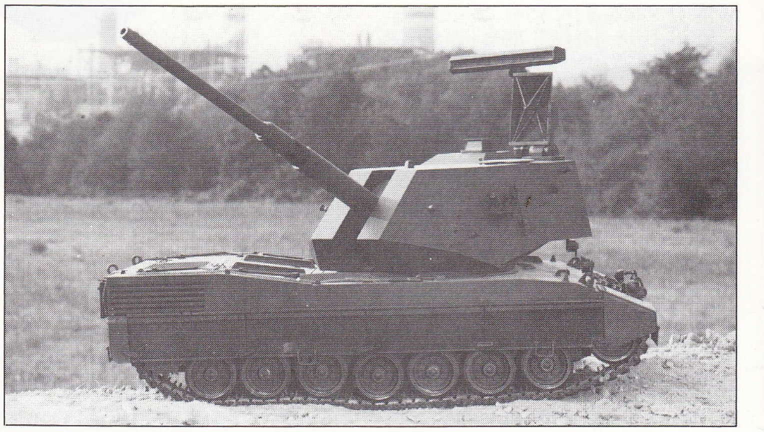
Powerplant: one Tatra T 912-2 6-cylinder diesel developing 110 hp (82 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range 500 km (311 miles); gradient 60 per cent; vertical obstacle 0.46 m (1 ft 6 in); trench 0.69 m (2 ft 3 in)

ITALY

OTOMATIC 76-mm self-propelled AA gun

The **OTOMATIC 76-mm 76/62** self-propelled anti-aircraft/anti-helicopter system has been developed by OTO Melara of La Spezia as a private venture specifically for the export market. It consists basically of a modified OF-40 MBT chassis fitted with a new all-welded turret armed with a 76-mm (3-in) automatic gun that is a direct development of the naval weapon of the same calibre and used by many navies around the world and also manufactured in Japan, Spain and the USA. The unique feature of the OTOMATIC compared with the many other systems on the market today is that it is designed specifically to engage and destroy attack helicopters before they themselve can release their missiles at the tank. Most self-propelled anti-aircraft/helicopter systems are in the 30-mm to 40-mm cannon bracket and have a maximum effective range of between 3000 and 4000 m (3,280 and 4,375 yards), and can therefore just about engage attack helicopters before they launch their deadly missiles. New generations of air-launched missiles are now under advanced development or even entering service (an example is the American Hellfire) which have an even longer range as well as a fire-and-forget capability. Once these are in service in significant numbers the attack helicopter will be able to stand off and attack tank formations without any danger of being destroyed by smaller-calibre self-propelled anti-aircraft gun systems.

The 76-mm (3-in) gun of the OTOMATIC is mounted in a turret with powered traverse, and the weapon has maximum elevation of +60° and a depression of −5°. Some 100 rounds of fixed ammunition are carried, of which 70 rounds are in the turret and the remaining 30 in the chassis; 25 of these rounds are in the automatic loading system for immediate use. For the engagement of aerial targets the weapon would fire high explosive or preformed fragmentation projectiles with either a point detonating or proximity fuse, while for the engagement of ground targets an APFSDS (armour-piercing discarding sabot) projectile is fired. According to the company, targets can be destroyed at a maximum range of at least 6000 m (6,560 yards), a six-round burst being considered sufficient for most targets. A comprehensive fire-control system is installed, and includes a search radar mounted on the rear of the turret and a tracking radar on the turret roof, both of which can be retracted if required. Mounted on each side of the turret is a bank of three electrically-operated smoke dischargers, while a 7.62-mm (0.3-in) machine-gun can be mounted on the turret roof for local protection. The first of two prototypes is now being built and should be ready late in 1984. Major sub-contractors are SMA, which is supplying the search and tracking radars, and Galileo, which is supplying the optronic and all-weather fire-control system.



A private venture by OTO-Melara, the OTOMATIC 76-mm self-propelled gun is designed to counter the threat of new-generation armoured helicopters with longer-ranged guided weapons.

Specification

OTOMATIC
Crew: 4
Weight: 46000 kg (101,411 lb)
Dimensions: length (gun forward) 9.635 m (31 ft 7 in); length (hull) 7.265 m (23 ft 10 in); width 3.35 m (11 ft 0 in); height (turret top) 3.152 m (10 ft 4 in)

Powerplant: one four-stroke supercharged diesel developing 1000 hp (746 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range (road) 500 km (311 miles); gradient 60 per cent; vertical obstacle 1.15 m (3 ft 9 in); trench 3.00 m (9 ft 10 in)